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Energy Research Abstracts

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UNITED STATES DEPARTMENT OF ENERGY

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Energy Research Abstracts

Purpose

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U.S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. Foreign information is obtained through the International Energy Agency's 13-nation Energy Technology Data Exchange, the International Atomic Energy Agency's International Nuclear Information System, or nation-to-nation agreements. **Please note that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.**

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The citations presented in *ERA* are available for on-line searching as records within the Energy Data Base. The current-year records are available on the Integrated Technical Information System (ITIS). The entire data base is available through commercial on-line vendors.

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Managing Editor, Audrey B. Smith
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21. **Drop note** or explanatory statement.
22. **Abstract.**
23. **Subject descriptors.** Listed only if no abstract or only a brief statement is included.

Sample Citations

Report

18494 (DOE/ER/40438–T1) **[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report.** Haeberli, W. Phys. VI collaboration. Wisconsin Univ., Madison (USA). Dept. of Physics. [1989]. 12p. Sponsored by DOE Energy Research. DOE Contract FG02-88ER40438. Order Number DE89007246/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper briefly discusses the Wisconsin test facility for storage cells; results of target tests; the new UHV...

Report Analytic

18500 (INIS-SU—69, pp. 30-32) **Transition energies in Ne-like ions. Correlation effects.** Vainshtejn, L.A. AN SSSR, Moscow. Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics. Collection.* Order Number DE89780060/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; INIS. Kratkie Soobshcheniya po Fizike.; no. 6.

SILVER IONS/energy-level transitions; XENON IONS/energy-level transitions; CORRELATIONS; D STATES; E STATES;...

Journal Article

19055 **A theoretical and experimental investigation of long-pulse, electron-beam-produced rare gas plasmas.** Brake, M.L.; Repetti, T.E. (Energy Beam Interaction Lab. of the Dept. of Nuclear Engineering, Univ. of Michigan, Ann Arbor, MI (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science (USA),* 16(5): 581-589 (Oct 1988). (CONF-881020–: Symposium on radiation physics, Sao Paulo, Brazil, October 3, 1988).

Visible emission spectroscopy (380-650 nm) has been performed on intense, electron beam (1 kA, 300 ns, 300 kV) produced Ar, Kr,...

Patent

18045 **Polarization of fast particle beams by collisional pumping.** Stearns, J.W. To Dept. of Energy, Washington, DC. USA Patent 4,724,117. 9 Feb 1988. Filed date 19 Oct 1984. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

A method for polarizing a fast beam of particles by collisional pumping, comprising the steps of generating a beam...

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The corporation, organization, or institution responsible for the issuance of the document is listed in this index. The entries are arranged alphabetically and provide the title and citation number of the reference. For example, the listing for the "Report" sample citation would appear as shown at right.

Wisconsin Univ., Madison (USA). Dept. of Physics
[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 14:18494 (R;US)
Wisconsin Univ., Madison (USA). Lab. of Genetics
Organization of the R chromosome region in maize: Final progress report, June 1, 1983–May 31, 1986, 14:18255 (R;US)

Personal Author Index
Each author's name listed on a document cited in this issue is indexed. An index entry provides title and citation number; for secondary and other names, a cross-reference is given to the primary author name where the full index entry is located.

Hadley, D.L., *See* Lee, A.D., 14:17651
Haeberli, W., [Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 14:18494 (R;US)

Subject Index
This index lists the main subject descriptors assigned to each record by indexing professionals. A secondary or qualifier term is used where necessary to describe materials, objects, and processes. Document titles may be enhanced with additional informative phrases where necessary. An excerpt from this index appears at right.

HYDROGEN ISOTOPES
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TRITIUM
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Study on the strong neutron-rich nuclei of lightest elements, 14:18686 (RA;SU;In Russian)

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DOE technical reports are listed by contract number. Each entry also provides the primary corporation or organization cited for that contract number. A typical entry is shown.

FG02-88ER40438 **Wisconsin Univ., Madison (USA). Dept. of Physics**
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FG02-88ER60664 **Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)**
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Report Number Index
Technical report literature is indexed by the alphanumerical identifier of the report. Patent documents and conferences are included for convenience. Each entry lists the citation number, the source of availability of the document, an indicator of presence at a GPO depository library, order number, and distribution category. A typical entry is:

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Energy Research Abstracts

01 COAL AND COAL PRODUCTS

0103 Preparation

37825 (DOE/PETC/TR–89/7) **Evaluation of advanced surface-modification, gravity, and electrostatic processes for fine-coal beneficiation.** Jacobsen, P.S.; Killmeyer, R.P.; Hucko, R.E. USDOE Pittsburgh Energy Technology Center, PA (USA). Jun 1989. 28p. Sponsored by DOE Fossil Energy. (CONF-8905145–1: COALPREP '89: 6th international coal preparation exhibition and conference, Lexington, KY, USA, 2-4 May 1989). Order Number DE89009026/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Pittsburgh Energy Technology Center (PETC) recently completed an inter-laboratory test program among six developers of advanced fine-coal-cleaning processes that exploit differences in surface modifications (gas mode), specific gravity (aqueous or heavy-liquid mode), or electrostatics (dry mode) to effect separations. These participating organizations received representative samples of three coals. They then ground them to an appropriate size and applied their particular process to each coal with the goal of producing a 2–3% ash clean coal with maximum energy recovery. The products were then returned to the PETC for analysis and performance evaluation. This paper will discuss the processes involved in this program and represent the results of the beneficiation tests. 4 refs., 10 figs., 9 tabs.

37826 **Kinetics of vacuum drying and rehydration in nitrogen of coals from the Argonne premium coal sample program.** Vorres, K.S. (Argonne National Lab., IL (USA)); Kolman, R. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 7-16 (1988). DOE Contract W-31-109-ENG-38. (CONF-8809161–: Symposium on research with Argonne premium coal samples, Los Angeles, CA, USA, 25-30 Sep 1988).

The kinetics of vacuum drying and rehydration in nitrogen of Wyodak-Anderson subbituminous, and Illinois #6 and Utah Blind Canyon high volatile bituminous coal samples have been studied at room temperature. Some samples were oxidized at room temperature. Several cycles of drying and rehydration were carried out on the same sample. The drying rates depended on particle size and moisture content of the sample. Several different mechanisms of moisture loss and rehydration were indicated by the kinetic data. The mechanism depended on particle size, coal rank, and degree of oxidation.

0104 Processing

Refer also to citation(s) 37894, 37901, 37903, 37905, 37906, 37916, 37929, 37993, 38885, 38886, 38909, 38910, 38911, 38912, 38913, 38914, 38915, 38916, 38917, 38918, 38921

37827 (ACERR–1989, pp. 5) **Characterization of coal for liquefaction processes.** Chakrabartty, S.K. (Alberta Research Council, Edmonton, AB, Canada). Alberta/Canada Energy Resources Research Fund, Edmonton, AB (Canada). [1989]. (CONF-8808237–: Thermal well completions seminar, Edmonton, Canada, 11 Aug 1988;CE–02653). In *Alberta Research Council [research reports].* Available from Alberta Energy and Natural Resources, Information Centre, 9920-108 St., Edmonton, AB, Canada T5K 2M4; $N/C.

This paper discusses the reactivity of coals or solvolysis and gives examples of thermolysis data on Western subbituminous coals reacted with donor solvent. It attempts to demonstrate that the behaviour of hvb-coals extends broadly to lower rank coals and that solvolytic reactions can be depended upon in the characterization of the feed coal for liquefaction. The solvolysis reactions were carried out in a hot tube by flash-heating at 400^0 C for 20 minutes and subsequent quenching by immersing the tube in cold water. The results of catalytic hydrogenation indicate that Alberta subbituminous coals are susceptible to this form of liquefaction. In conclusion, the reaction of tetralin with subbituminous coals at or near 400^{0}C is indicative of their liquefaction potential. In this reaction, coal acts as an oxidant and dehydrogenates tetralin; 100-200 millimole of tetralin are incorporated with 100 g of coal-organics. The overall reaction products show higher solubility than the parent coal, and provide increased distillate yield. 9 refs., 5 tabs.

37828 (DOE/EIA–0120(79)) **Coke and coal chemicals in 1979.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal and Electric Power Statistics. 31 Oct 1980. 41p. Sponsored by DOE Management & Administration. Order Number DE89014987/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report continues the annual series on coke and coal chemicals stated in the 1920's by the Bureau of Mines, Department of the Interior, as a Mineral Industry Survey. The last Bureau of Mines publication in this continuing series was for 1975. Since that time the Energy Information Administration has published these reports. This report combines the data previously published as 3 separate reports on coke and coal chemicals, coke and breeze distribution, and coke producers in the United States. The information in this report was collected by the Coal Statistics Division, Office of Coal and Electric Power Statistics, Energy Information Administration, from respondents on Form EIA-5 and 5A. The data contained herein were compiled from mandatory reports submitted by companies that operated coke plants.

37829 (DOE/MC/19122–2699-Vol.1) **Cold flow scaleup facility experimental results and comparison of performance at different bed configurations, Volume 1: Topical report, January–December 1983.** Schmidt, D.K.; Yang, W.C.; Ettehadieh, B.; Anestis, T.C.; Haldipur, G.B.; Kettering, E.; O'Rourke, R.E.; Weigle, D. Kellogg (M.W.) Co., Houston, TX (USA). Dec 1988. 194p. Sponsored by DOE Fossil Energy. DOE Contract AC21-82MC19122. Order Number DE89000980/JAW. Available from NTIS, PC A11/MF A01 - OSTI; GPO Dep.

KRW Energy Systems Inc. is engaged in the continuing development of a pressurized, fluidized-bed gasification process at its Waltz Mill Site in Madison, Pennsylvania. The overall objective of the program is to demonstrate the viability of the KRW process for the environmentally acceptable production of low- and medium-BTU fuel gas from a variety of fossilized carbonaceous feedstocks for electric power generation, synthetic natural gas, chemical feedstocks and industrial fuels. This report presents analysis of the Cold Flow Scaleup Facility (CFSF) operations. Included is work performed on the 3-meter CFSF model using four different bed configurations to check correlations and scale-up criteria developed from studies conducted in small-scale cold flow units and those available in open literature. The 3-meter model permits full front-face viewing of the fluidized bed through a transparent plastic window and with its instrumentation allows detailed studies of jet behavior, bubble dynamics, solid circulation, gas mixing, and related phenomena important to the design of a large-scale gasifier. 87 refs., 95 figs., 56 tabs.

37830 (DOE/MC/19122–2699-Vol.2) **Cold flow scaleup facility experimental results and comparison of performance at different bed configurations, Volume 2: Topical report, January–December 1983.** Schmidt, D.K.; Yang, W.C.; Ettehadieh, B.; Anestis, T.C.; Haldipur, G.B.; Ketrering, E.; O'Rourke, R.E.; Weigle, D. Kellogg (M.W.) Co., Houston, TX (USA). Dec 1988. 140p. Sponsored by DOE Fossil Energy. DOE Contract AC21-82MC19122. Order Number DE89000981/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

KRW Energy Systems Inc. is engaged in the continuing development of a pressurized fluidized-bed gasification process at its Waltz Mill Site in Madison, Pennsylvania. The overall objective of the program is to demonstrate the viability of the KRW process for the environmentally acceptable production of low- and medium-BTU fuel

gas from a variety of fossilized carbonaceous feedstocks for electric power generation, synthetic natural gas, chemical feedstocks, and industrial fuels. This report presents the experimental data on the Cold Flow Scaleup Facility (CFSF) operations.

37831 (DOE/MC/24268–2700) **Development of an advanced, continuous mild gasification process for the production of co-products: Topical report.** Cha, C.Y.; Merriam, N.W.; Jha, M.C.; Breault, R.W. Western Research Inst., Laramie, WY (USA); AMAX Research and Development Center, Golden, CO (USA); Riley Stoker Corp., Worcester, MA (USA). Jun 1988. 305p. Sponsored by DOE Fossil Energy. DOE Contract AC21-87MC24268. Order Number DE89000967/JAW. Available from NTIS, PC A14/MF A01 - OSTI; GPO Dep.

Research on mild gasification is discussed. The report is divided into three sections: literature survey of mild gasification processes; literature survey of char, condensibles, and gas upgrading and utilization methods; and industrial market assessment of products of mild gasification. Recommendations are included in each section. (CBS) 248 refs., 58 figs., 62 tabs.

37832 (DOE/METC–89/6100) **Proceedings of the separations technology workshop for coal gasification.** Baird, M.J.; Jarr, L.A.; Longanbach, J.R.; Williams, M.C. (eds.). USDOE Morgantown Energy Technology Center, WV (USA). 8 Dec 1988. 170p. Sponsored by DOE Fossil Energy. (CONF-881227–: Separation technology workshop for coal gasification, Morgantown, WV, USA, 8 Dec 1988). Order Number DE89000905/JAW. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

On December 8, 1988, the Morgantown Energy Technology Center sponsored the workshop "Separation Technology Workshop for Coal Gasification." The purpose was to bring together experts in various separation and fossil fuel conversion areas to discuss common problems and possible solutions that could lead to the more rapid development of economically viable coal gasification-based processes. The workshop was organized into four sessions: (1) gas-gas separations, (2) gas-particle separations, (3) liquid-particle separations, and (4) liquid-liquid separations. Two invited speakers gave presentations at each session: one presented an overview of the separations area, and the other discussed practical applications. Individual projects are processed separately for the data bases.

37833 (DOE/PC/88915–T3) **Steam gasification of carbon: Catalyst properties: Reporting period, March 15, 1989–June 14, 1989.** Falconer, J.L.; Lauderback, L.L. Colorado Univ., Boulder, CO (USA). 27 Jun 1989. 7p. Sponsored by DOE Fossil Energy. DOE Contract FG22-88PC88915. Order Number DE89015150/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This research uses three techniques to study catalyzed gasification of carbon in an effort to determine the concentration of catalyst sites on a carbon surface and thus determine how effectively a catalyst is utilized for steam gasification. Both alkali and alkaline earth oxides are effective catalysts for accelerating the gasification rate of coal chars, but in many cases only a fraction of the catalyst is in a form that is effective for gasification. We will study the steam gasification of carbon in order to determine the concentration of active catalyst sites, the composition of the catalyst, and the location of the catalyst on the surface. Transient isotope tracing (switching reactant feed gases between $H_2{}^{16}O$ and $H_2{}^{18}O$) will be used to measure the concentration of sites at steady-state reaction conditions. A steady flow of $H_2{}^{16}$ O in He will be replaced by $H_2{}^{18}O$ in He, while maintaining the same reaction rate, and the change in product signals will be detected with a computer-controlled mass spectrometer. Secondary ion mass spectrometry (SIMS) will be used for both high surface area samples of carbon/carbonate mixtures that are heated in steam to various temperatures and for model surfaces with deposited ions. SIMS will provide a direct measurement of surface composition. Scanning tunneling microscopy (STM), a technique that provides atomic resolution images of surfaces, will be used to determine catalyst dispersion and the location of catalyst on the surface. The interrelation of the results from these techniques (for potassium and calcium catalysts) will provide knowledge of catalyst dispersion, composition, and utilization. Such knowledge is needed for optimal use of catalysts in steam gasification of coal char.

37834 (GAO/RCED–88-172) **Synthetic fuels.** General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. 1988. 19p. Available from General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Great Plains Project, located near Beulah, North Dakota, is the nation's only commercial-scale coal gasification plant built to produce synthetic natural gas of pipeline quality. GAO's cash-flow analysis showed that if the ANG Coal Gasification Company continued to operate the project under the Department of Energy ownership, the government's net financial return from gas sales, by-product sales, and pipeline transportation fees would be about $1.5 billion over the project's remaining 22-year operating life. The $1.5 billion would have a present value of about $569 million. From 1988 through 2009 the project would generate about $6.9 billion in total revenues. For the federal government to be as financially well off from selling the project as it would expect to be from retaining ownership, the project would have to be sold for about $1 billion. A $1.029 billion sale price is needed for the government to receive an income that would equate to the $569 million present value figure that GAO calculated as the project's retention value.

37835 (LBL–27175) **Catalytic gasification of graphite and chars.** Heinemann, H.; Somorjai, G.A.; Pereira, P.; Carrazza, J. Lawrence Berkeley Lab., CA (USA). May 1989. 11p. Sponsored by DOE Fossil Energy. DOE Contract AC03-76SF00098. (CONF-890401–13: 197. national meeting of the American Chemical Society, Dallas, TX, USA, 9-14 Apr 1989). Order Number DE89014907/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The present paper presents information on the role of ash components on catalytic gasification and describes another type of catalyst, namely a mixture of alkali and earth alkali oxides such as K_2O-CaO which is almost as active and is less sensitive to poisoning than the potassium-nickel composition. Four chars ranging from lignite to bituminous coal char were gasified along with graphite in the presence of various catalysts. The chars and their composition are summarized. 5 refs., 6 figs., 4 tabs.

37836 **Pyrolysis modeling of the Argonne premium coals.** Serio, M.A. (Advanced Fuel Research, Inc., East Hartford, CT (USA)); Solomon, P.R.; Yu, Z.Z.; Deshpande, G.V.; Hamblen, D.G. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 91-101 (1988). DOE Contract AC21-86MC23075. (CONF-8809161–: Symposium on research with Argonne premium coal samples, Los Angeles, CA, USA, 25-30 Sep 1988).

The establishment of the Argonne Premium Sample Bank provides a good opportunity to test a recently developed general model of coal devolatilization. The model, which is called FG-DVC, combines a functional group model for gas evolution (FG) and a statistical model for tar formation (DVC). It assumes that the kinetics of functional group decomposition are independent of coal type, but that the amounts do vary with coal type. The rank dependence of the tar yield, tar molecular weight distribution, extract yields, and viscosity are explained by the rank dependence of CO_2 yields according to this model. The early evolution of CO_2 in low rank coals appears to lead to crosslinking at low temperatures and hence thermosetting behavior, low tar yields, and low extract yields. The validation of the FG-DVC model was previously done for two coals, North Dakota lignite and Pittsburgh Seam bituminous. The Argonne Premium Sample set provides six more coals and different samples of these same two coals for comparison. In order to compare with data over a wide range of conditions, pyrolysis experiments were done in three different reactor systems, as described below.

37837 **Measurement of particle temperatures during coal pyrolysis and combustion.** Huang, G. (Pennsylvania State Univ., University Park (USA)); Vastola, F.J.; Scaroni, A.W. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 1-7 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

The surface temperature of pyrolyzing and/or burning coal particles has been the subject of intensive investigation because it is important in the estimation of the rate of devolatilization and/or carbon oxidation. A number of models have been established in order to predict the surface temperature of pulverized coal particles

smaller than 200 μm diameter. However, few convincing models for millimeter size coal particles have emerged because of the complication of temperature gradients within the particle. The ignition mechanism of coal particles in a hot oxidizing atmosphere is another subject of debate. Further experimental work is needed to determine whether initial ignition occurs homogeneously in the gas phase or heterogeneously at the particle surface. The work presented here had three objectives: firstly, to develop a technique to monitor the transient temperature variations in the gas phase around a single particle during pyrolysis and/or combustion; secondly, to extrapolate the data to estimate the particle surface temperature; and thirdly, to analyze the ignition mechanism of coal and char particles.

37838 Intra-particle heat transfer effects in coal pyrolysis. Hajaligol, M.R. (M.I.T., Cambridge, MA (USA)); Peters, W.A.; Howard, J.B. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 8-17 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

Time and spatial temperature gradients within pyrolyzing coal particles can exert strong effects on devolatilization behavior including apparent pyrolysis kinetics. This paper mathematically models transient spatial non-isothermalities within an isolated, special coal particle pyrolyzing by a single first-order reaction. The analysis provides three distinct indices of heat transfer effects by quantitatively predicting the extent of agreement between: (a) centerline and surface temperature; (b) volume averaged pyrolysis rate; or (c) volume averaged pyrolysis weight loss and the corresponding quantity calculated using the particle surface temperature for the entire particle volume. Regimes of particle size, surface heating rate, and reaction time where particle isothermality according to each of criteria (a) through (c) is met to within prescribed extents, are computed for conditions of interest in entrained gasification and pulverized coal combustion, including pyrolysis under non-thermally neutral conditions.

37839 Thermokinetic transport control and structural microscopic realities in coal and polymer pyrolysis and devolatilization: their dominant role in dust explosions. Hertzberg, M. (Bureau of Mines Pittsburgh Research Center, PA (USA)); Zlochower, A.; Conti, R.S.; Cashdollar, K.L. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 24-41 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

The reaction mechanism for coal pyrolysis and devolatilization involves the inward progression from the exposed surface of a decomposition wave, whose speed of propagation determines the pyrolysis rate. The speed is controlled by the heat flux driving the wave and by thermodynamic transport constraints within the particle. Microscopic data are presented that reveal the structure of that wave front for unidirectional laser exposure of both macroscopic coal samples and microscopic dust particles. At burner-level heat fluxes of 100 to 125 W/cm^2, the wave front thickness is less than 50 μm. New data are also presented for polymethylmethacrylate (PMMA) at flux levels of 12-115 W/cm^2 that give a pyrolysis and devolatilization rate coefficient of $K_T = (\int T_s/T_o\ C(T)dT + \Delta H_v)^{-1}$, whose value is predictable from thermodynamic transport constraints alone. Except for the complication of the coal's char-layer residue and its increasing thickness, which insulates the wave front from the heat source flux that drives it, both coal and PMMA behave similarly. For PMMA, the decomposition temperature, T_s, is 350-400°C; for coal it is 450-600°C.

37840 Significance of transport effects in determining coal pyrolysis rates and yields. Suuberg, E.M. (Brown Univ., Providence, RI (USA)). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 51-58 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

The recent search for robust but mathematically simple models of coal pyrolysis has led to many significant advances in the area of modeling the wide range of chemical reactions responsible for many key phenomena (gas release, tar formation). It has also become clear that transport phenomena cannot be disregarded in such models. There has emerged a debate concerning the role of heat transfer and various mass transfer processes in determining both the overall timescales of pyrolysis, and the compositions of products from these processes. Many of the earlier theories concerning the role of transport processes in coal pyrolysis were reviewed in various recent publications (Howard, 1981; Gavalas, 1982; Suuberg, 1985). It seems appropriate in the context of this symposium to review some recent developments and conclusions.

37841 Diffusional contributions to volatile release in pyrolyzing coal particles. Misra, M.K. (Ohio State Univ., Columbus (USA)); Essenhigh, R.H. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 59-67 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

Unsteady state calculations of pyrolyzing coal particles under slow and rapid heating have been compared with experimental data for particles in the size range 20 microns to 4 mm; and the comparison has shown, contrary to common assumption, that the diffusional escape is an important factor in determining the pyrolysis times for all particle sizes. Pyrolysis times for particles greater than 500 microns range from 0.1 to 10 sec; and for particles less than 100 microns range from 0.05 to 0.5 sec with an unexpected overlap in times. This overlap is accounted for by assuming that the diffusion coefficients for the escaping volatiles are about 100 times greater (order of 10^{-1}cm^2/sec) for the larger particles than for the smaller particles (order of 10^{-5}cm^2/sec). This result raises the questions regarding purely kinetic interpretations of pyrolysis rate data for small particles.

37842 Mathematical simulation of the pyrolysis of a model asphaltene. Savage, P.E. (Univ. of Delaware, Ann Arbor, MI (USA)); Klein, M.T. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 68-78 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

Reaction engineering experiments with coal or heavy oil fractions typically allow observation of only global kinetics and the yields of lumped product fractions; the controlling reaction fundamentals are obscured by the complexity of the reactant and its product spectra. This limitation has motivated experiments with model compounds to help resolve the fundamental reaction pathways, kinetics, and mechanisms involved. These fundamentals are of the model compound reactions, however, and their relation to the reactions of the moieties they mimic in a complex reactant can be vague. Model compound results are often used in the analysis of the reactions of coal or asphaltenes in a qualitative fashion. The object of this paper is to report on a mathematical model of asphaltene pyrolysis which serves as a quantitative bridge between model compounds and actual asphaltenes by combining model-compound deduced reaction pathways and kinetics with aspects of asphaltene structure.

37843 General model of coal devolatilization. Solomon, P.R. (Advanced Fuel Research, Inc., East Hartford, CT (USA)); Hamblen, D.G.; Carangelo, R.M.; Serio, M.A.; Deshpande, G.V. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 83-98 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

This paper presents a general model for coal devolatilization which considers the evolution of gas, tar, char and guest molecules. The general model combines two previously developed models, a Functional Group (FG) model and a Devolatilization-Vaporization-Crosslinking (DVC) model. The FG model considers the parallel independent evolution of the light gas species formed by the decomposition of functional groups. Alternatively, functional groups can be released from the coal molecule attached to molecular fragments which evolve as tar. The kinetic rates for the decomposition of each functional group and for tar formation have been determined by comparison to a wide variety of data, a first approximation, these rates are insensitive to coal rank. The FG model uses an adjustable parameter to fit the total amount of tar evolution. This parameter depends strongly on the details of the time-temperature history of the sample, the external pressure, and the coal concentration and, therefore, varies with the type of experiment performed.

37844 Kinetic modeling of coal pyrolysis in a laminar-flow reactor system. O'Brien, W.S. (Southern Illinois Univ., Carbondale (USA)); Chen, J.W.; Moslehi, A.; Wu, R.C.R. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 99-105 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

In this presentation, experimental weight-loss data from the devolatilization treatment of a Herrin (Illinois) No. 6 coal in a laminar-flow laboratory reactor are examined. The observed reaction behavior are used to outline criteria for a coal-pyrolysis kinetic model.

37845 Advances and new directions in direct liquefaction. Rao, S.N. (Burns and Roe Services Corp., Pittsburgh, PA (USA)); Schindler, H.D.; McGurl, G.V. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 145-156 (1988). (CONF-8809273–: Coal liquefaction, Los Angeles, CA, USA, 25-30 Sep 1988).

With advance in single stage processes such as H-Coal, EDS and SRC, and refining and upgrading of coal liquids by Chevron and UOP, the direct liquefaction process has continuously evolved to the present two-stage catalytic configuration, which produces the highest liquid yield and product quality of any process worldwide. The Two Stage Liquefaction (TSL) process has been successfully applied to bituminous and subbituminous coals, overcoming problems associated with earlier processes. But, potential for additional improvement is recognized in several areas: cleaning coal prior to liquefaction; low temperature and pressure preconditioning of feed coal; novel catalysts development to arrest regressive reactions and improve hydrotreatment and cracking reactions; improvement in hydrocarbon value recovery and reduced energy rejection by alternate bottoms processing techniques. In this paper, after discussing briefly the history of liquefaction and development of the TSL process, present potential areas for research and development are presented.

37846 Two-stage coal liquefaction process developments at Wilsonville. Lee, J.M. (Catalytic Inc., Wilsonville, AL (USA)); Davies, O.L.; Pinkston, T.E.; Gough, J.R. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 157-171 (1988). (CONF-8809273–: Coal liquefaction, Los Angeles, CA, USA, 25-30 Sep 1988).

A recently completed close-coupled integrated (CC-ITSL) processing mode was an important development in the Wilsonville program for making clean distillate fuels. In the CC-ITSL mode the two reactors were directly coupled without any pressure letdown. Interstage cooling was done only to the extent required to control the second reactor temperature. Such close-coupled operation should offer several process benefits such as increased overall thermal efficiency, reduced potential for retrogressive reactions which may take place in the absence of hydrogen at longer residence times, and improved product quality. This paper is focused on two-stage coal liquefaction process performance with close-coupled reactors. Results are presented for two runs: Run 253 and Run 254. Run 253 processed high ash Illinois No. 6 coal and used Shell 317 1/20" trilobe bimodal catalyst in both reactors. Product yield and product quality data are discussed. Catalyst performance comparisons for Shell 317 (Run 253) and Amocat 1A and 1C (Run 251-I and Run 252) are made in terms of distillate yields, catalyst deactivation and catalyst replacement rates. Run 254 processed low ash Ohio No. 6 coal and used Shell 317 1/20" trilobe bimodal catalyst in both reactors. The effects on process performance of the low ash feed coal, high resid recycle, high second stage reaction temperature and high space velocity are presented. The effect of the coal type on the distillate yield is discussed in comparisons of Illinois No. 6 and Ohio No. 6 coals. The first stage catalyst equilibrium activity level is discussed. Catalyst performance data at different second stage reaction temperatures are presented in terms of catalyst deactivation and catalyst replacement rates. Optimum and cascading catalyst requirements are discussed.

37847 Progress in direct coal liquefaction: the economic perspective. Gray, D. (MITRE Corp., McLean, VA (USA)); Tomlinson, G. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 172-179 (1988). DOE Contract AC04-76DP00789. (CONF-8809273–: Coal liquefaction, Los Angeles, CA, USA, 25-30 Sep 1988).

The economic impact of demonstrated and projected improvements in two-stage direct coal liquefaction processes are evaluated. The computerized methodology employed estimates the quantity and quality of products from a 30,000 ton/day commercial scale plant, based on input test data. Steam, hydrogen and fuel gas balances are determined. Capital and operating costs are then estimated, and the required selling price of raw liquid products is determined by conventional discounted cash flow (DCF) analysis. Product quality is quantified by computing the cost of upgrading the raw products to motor gasoline. Improvements in two-stage processing since the early demonstration of the Lummus Integrated Two-stage (ITSL) process in 1980 are shown to reduce the required initial selling price (RISP) of gasoline from coal liquids by about 16%. Further process improvements, which offer the potential for an addition 16% RISP reduction, are identified. This report also compares the economics of two-stage processing with earlier studies of the H-Coal, Exxon Donor Solvent and Lummus ITSL processes. The high costs of coal liquids found in these earlier studies are explained and revised costs for these earlier plants using a common financial and technical basis are determined.

37848 Recycle oils from fluid coking of coal liquefaction bottoms. Winschel, R.A. (Consolidation Coal Co., Library, PA (USA)); Burke, F.P. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 180-187 (1988). DOE Contract AC22-84PC70018. (CONF-8809273–: Coal liquefaction, Los Angeles, CA, USA, 25-30 Sep 1988).

A series of nine fluid-coker tars, produced by Lummus-Crest, Inc., from coal liquefaction vacuum bottoms, was characterized to evaluate their use as liquefaction recycle oils. The primary variables in the coking tests were temperature (1000 to 1200°F) and coker feedstock source. The properties of the tars are principally influenced by the coking temperature. Those produced at higher temperature are more aromatic and contain less hydrogen, and are principally unsubstituted and methyl-substituted condensed aromatic compounds. The tars produced at 1000°F are expected to be poor hydrogen donor solvents, whereas those produced at 1200°F are not expected to be hydrogen donor solvents. However, a 1200°F tar was readily hydrotreated to produce a good to excellent donor solvent. Based on these results, it would appear that tars produced from fluid coking of liquefaction vacuum bottoms can be recycled to a catalytic liquefaction reactor to produce additional liquids without adversely affecting process performance.

37849 Direct coal liquefaction: distinction between reactants and catalysts. Moroni, E.C. (Dept. of Energy, Washington, DC (USA)). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 198-201 (1988). (CONF-8809273–: Coal liquefaction, Los Angeles, CA, USA, 25-30 Sep 1988).

An extensive research and development program on disposable catalysts and slurry catalysis was supported by the Fossil Energy Office of the US Department of Energy (DOE) during the period 1978-82. Actually, prior to 1978, a project of similar nature was carried out for several years, at a low priority effort, at the US Department of Interior, Bureau of Mines laboratories which is now known as the Pittsburgh Energy Technology Center (PETC). Although numerous slurry-phase catalysts were tested in this program, two metals, iron and molybdenum, in their sulfided form, were singled out as the most promising candidates for scale-up processing. This paper intends to provide evidences that the active forms of iron sulfides have a different function than the other metal sulfides, the function of being reactants and catalysts. An additional objective of this paper, in conjunction with a series of papers presented by this author in recent years, is to stimulate the research community, dedicated to coal liquefaction fundamentals, to undertake a more systematic research approach to discriminate the critical reactions from the numerous ones occurring particularly the lower temperature range, which, in turn, profoundly affect the subsequent reactions occurring at the higher temperatures.

37850 Role of coal devolatilization in comprehensive combustion models. Brewster, B.S. (Brigham Young Univ., Provo, UT (USA)); Baxter, L.L.; Smoot, L.D. *Preprints of Papers, American*

Chemical Society, Division of Fuel Chemistry (USA), 32(3): 106-116 (1988). (CONF-870802--: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

Pulverized coal combustion is a complex interaction of several processes, including particle dispersion, gas-phase mixing, particle heatup and mass transfer, particle and gas reactions, recirculating and swirling fluid mechanics, radiative heat transfer, mineral matter phase transformations, and pollutant formation and destruction. Comprehensive models which include submodels for many of these processes have been developed by several investigators to predict local conditions inside combustors. This paper focuses on the role of coal devolatilization submodels in such predictions. The objectives of this paper are (1) to present theoretical results from an investigation of several thermal effects on devolatilization for single particles and in a comprehensive predictive model and (2) to illustrate the importance of considering chemistry/turbulence interactions when extending the model to allow for variable composition of the coal volatiles. The comprehensive model that was used is PCGC-2, Pulverized Coal Gasification or Combustion-2 Dimensional (axisymmetric). Thermal effects that were investigated include variable particle heat capacity, particle emissivity, heat of reaction during devolatilization, and volatiles heating value.

37851 **Effect of pressure on pyrolysis of a sub-bituminous coal in an entrained-flow reactor.** Fatemi, M. (Pennsylvania State Univ., University Park (USA)); Scaroni, A.W.; Lee, C.W.; Jenkins, R.G. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 117-124 (1988). (CONF-870802--: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

To help product advances in gasification technologies it is necessary to generate data on the effect of coal properties and operating variables on the pyrolysis/gasification behavior of coals under conditions similar to those in advanced-concept gasifiers; usually a high temperature-high pressure environment for entrained coal particles. Since relatively little data are available on coal pyrolysis/gasification at elevated pressure, especially in entrained flow systems, the primary objective of this study was to provide information on the effect on product yield and composition during pyrolysis.

37852 **Modeling of coal pyrolysis under the conditions of an entrained phase reactor.** Wanzl, W. (Bergbau-Forschung GmbH (Germany, F.R.)); KaBler, P.; van Heek, K.H.; Juentgen, H. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 125-128 (1988). (CONF-870802--: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

Experimental laboratory work has shown that yield and quality of liquid products from coal pyrolysis can be controlled and optimized to a certain extent by suitable coaction of the primary thermal coal decomposition reactions and the secondary cracking or hydrocracking of the volatiles. The results indicate that favorable process conditions are provided in an entrained phase transport reactor which enables high heating rates for fast primary coal pyrolysis together with optimum residence time of the volatiles for secondary cracking and hydrocracking in the heated reactor zone. From that point of view the question arises how thermal coal decomposition can be described at high heating rates and whether transport limiting processes are involved in the overall reaction step. Especially for reactor design it is necessary to clarify to what extent experimental kinetic data gained at low heating rates can be applied to heating conditions like in a fluidized bed or in an entrained phase reactor.

37853 **Effect of heat transfer on tar and light gases from coal pyrolysis.** Freihaut, J.D. (United Technologies Research Center, East Hartford, CT (USA)); Proscia, W.M.; Seery, D.J. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 129-141 (1988). (CONF-870802--: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

This report presents the results of a study of coal pyrolysis in three different reactors covering a wide range of heating conditions. The specific purpose of the investigation was to determine if the rate of heat delivery to a high volatile bituminous coal during the tar formation and evolution phase has a significant effect on the tar yields and molecular weight distribution for a high volatile bituminous coal. From the point of view of understanding coal devolatilization and the development of fundamental kinetic models, the investigation is geared to determining whether the same tar formation and evolution processes are occurring in widely different regimes of heat transfer rate and modes of heat transfer. The heavy hydrocarbons yields and chemical characteristics provide a type of observable monitor, to generate a microscopic model of the devolatilization/pyrolysis process.

37854 **Pyrolysis of coal at high temperatures.** Nelson, P.F. (CSIRO Division of Fossil Fuels, North Ryde (Australia)); Smith, I.W.; Tyler, R.J. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 142-147 (1988). (CONF-870802--: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

This paper presents data on the pyrolysis of a subbituminous coal and of tar produced by the rapid pyrolysis of this coal in a small fluidized bed reactor and in a shock tube. Kinetic parameters for light gas formation from secondary reactions of the tar have been determined. The results also provide evidence that secondary reactions of the tar are a source of polycyclic aromatic hydrocarbons (PAH) observed during pyrolysis. Data are also presented to show the effect of preparation conditions on the combustion kinetics of chars produced by rapid pyrolysis.

37855 **Low temperature isothermal pyrolysis of Illinois No. 6 and Wyodak coal.** Miknis, F.P. (Western Research Institute, Laramie, WY (USA)); Turner, T.F.; Ennen, L.W. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 148-157 (1988). (CONF-870802--: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

As a first step towards a systematic approach to understanding the relationship between coal structure and its conversion during pyrolysis, this paper presents isothermal decomposition studies in the temperature range of 375°C to 425°C have been conducted on Illinois No. 6 and Wyodak coals. While prevailing attitudes favor the use of nonisothermal techniques to study coal pyrolysis, these techniques do not easily allow direct measurement of all the reaction products. Consequently, detailed chemical analyses of the reaction products are usually absent in such studies. In particular intermediate states such as the metaplast are seldom measured directly. With isothermal methods, it is possible to measure all the products of thermal decomposition including soluble intermediates. In addition to obtaining the overall weight conversions to products, detailed chemical and spectroscopic analyses can be obtained for each product class. For example, elemental analyses of all the products provide detailed carbon, hydrogen, sulfur, nitrogen, and oxygen balances. Solid and liquid state ^{13}C NMR measurements can be used to determine the partitioning of aliphatic and aromatic carbon in the products.

37856 **Changes in the degree of substitution of PAC from pyrolysis of a high volatile bituminous coal.** Wornat, M.J. (Massachusetts Institute of Technology, Cambridge (USA)); Sarofim, A.F.; Longwell, J.P. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 158-174 (1988). (CONF-870802--: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

When pyrolyzed, coal forms a complex mixture of polycyclic aromatic compounds (PAC), many of which carry functional groups as substitutes for ring hydrogen. Further subjection of PAC to pyrolytic conditions causes changes in their composition – manifested partly by changes in the degree of substitution. The presence or absence of substituent groups is of importance to environmental issues concerning both the sources of environmental PAC and their health effects. Researchers studying PAC in the air, water, and soil have tried to deduct information about the PAC source fuels and their process temperatures from relative abundances of certain alkylated and unalkylated PAC. Focusing particularly on alkyl and amino substituents, several researchers have attempted to establish a link between biological activity (i.e., carcinogenicity or mutagenicity) and the presence or absence of substituent groups. It is our objective to determine how the degree of substitution and the nature of the substituent groups influence the pyrolysis behavior of coal-derived PAC.

37857 Case for induced bond scission during coal pyrolysis. McMillen, D.F. (SRI International, Menlo Park, CA (USA)); Malhotra, R.; Nigenda, S.E. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 180-188 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

Most coal pyrolysis models invoke spontaneous thermal scission of inherently weak bonds as the sole pyrolytic reaction leading to depolymerization of coal structures. In this view, bond scission is dependent only on temperature; the only additional chemical factors that impact the net cleavage are scavenging and crosslinking of thermally generated radicals, which can be affected primarily by varying heating rates and other factors that affect heat and mass transport. In contrast to this traditional picture, data obtained by various researches (partly in the context of coal liquefaction), when taken together, provide a strong argument that induced scission of strong bonds plays a significant role during coal pyrolysis. In this paper we attempt to summarize this argument. In the following paragraphs, we outline some of the evidence that induced bond scission can take place under pyrolysis conditions, and show how including them helps explain certain coal conversion phenomena.

37858 Desorption turnover numbers for the carbon-oxygen reaction. Ranish, J.M. (General Electric Company, Cleveland, OH (USA)); Walker, P.L. Jr. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(4): 132-137 (1987). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA (USA), 30 Aug - 4 sep 1987).

For graphitic carbons reacting with O_2, it is well established that the C atoms in the gasification products originate from the active surface, the (11 $\int$) and (10 $\int$) planes. Even when the basal plane is gasified, it is gasified at defects which expose C atoms in these planes. The gasified atoms are produced via either or both of the reactions below depending upon the reaction conditions. Although low temperature O_2 chemisorption techniques have been used to measure the active surface, the part of the active surface actually measured and its relationship to the part involved in the gasification, the covered strongly desorbing part, is not always clear. Aside from an in situ spectroscopic examination of the surface which, as yet, is undeveloped, a better way to estimate the surface involved in gasification may be to cool down a gasifying sample in O_2 and then measure the surface O content. At the instant of cooldown, the surface oxides consist of stable and unstable types. As the temperature decreases, more of the unstable surface oxides become stable. Some of the unstable surface oxides desorb but should be replaced because the activation energies for adsorption and migration of O species are smaller than the activation energy for desorption. The replacement of recently desorbed surface oxide would be less complete as the kinetics become less dominated by the desorption step. This limits the technique to low temperature, high O_2 pressure gasification. The cooled sample then contains oxygen originating from both the stable and unstable surface oxides. This oxygen can be recovered as CO and CO_2 by heating the surface oxides to about 1240 K. This technique was used to study the gasification of a spectroscopic purity graphite powder in various pressures of O_2 at temperatures low enough so that the observed gasification gates were clearly chemically controlled.

37859 Coprocessing of coal with high metal content resids. Miller, T.J. (Univ. of Pittsburgh, PA (USA)); Panvelker, S.V.; Wender, I.; Tierney, J.W.; Shah, Y.T.; Huffman, G. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 202-209 (1988). DOE Contract FC22-85PC80009. (CONF-8809273–: Coal liquefaction, Los Angeles, CA, USA, 25-30 Sep 1988).

The composition of coal-derived recycle solvents is very different from that of heavy oils. The former are highly aromatic and hydroaromatic while the latter are mostly paraffinic and naphthenic. Thus, it should be expected that coal conversion in a heavy oil, in general, would be less than in a coal-derived solvent in the absence of a catalyst. However, it is possible to achieve a high degree of conversion by proper choice of host oil, operating conditions, or by pretreating the host oil before it is used for liquefaction. Yan and Espenscheid have reported that 90% conversion of Illinois No. 6 coal to pyridine-solubles was achieved by liquefying the coal in bottoms from a fluid catalytic cracking unit without using any catalyst as this solvent was highly aromatic. Similar high conversions have been reported by researchers using catalysts. Curtis et al have reported that petroleum residua are deficient in labile hydrogen; however, if a catalyst is used under hydrogen atmosphere, coprocessing can proceed with fairly high conversions. It is possible to increase the liquefying efficacy of a residuum by its prior hydrocracking, or by adding external hydrogen donors. This paper presents the results of thermal (with no added catalyst) coprocessing of Illinois No. 6 (hvBb) coal with Maya (650°F+) ATB residual oil and with whole Boscan crude. The relationship between reaction conditions and coal conversion and product selectivity has been studied. The removal of vanadium during coprocessing has been investigated. The results on heteroatom removal reactions have also been presented as the amount of heteroatoms in petroleum is often correlated with that of metals.

37860 Studies of deactivating species on coal liquefaction catalysts. Stohl, F.V. (Sandia National Labs., Albuquerque, NM (USA)); Malhotra, R. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 210-220 (1988). DOE Contract AC04-76DP00789. (CONF-8809273–: Coal liquefaction, Los Angeles, CA, USA, 25-30 Sep 1988).

The ultimate objectives of the catalyst deactivation work reported here are to determine how the deactivation due to hydrotreating strongly basic nitrogen compounds occurs on the catalyst surface and to identify the compounds that cause the deactivation. The work reported here is aimed at evaluating the usefulness of Field Ionization Mass Spectrometry (FIMS) analyses for the catalyst deactivation studies. Results of the application of FIMS techniques to characterize the compounds volatilized from the aged catalysts and the liquid products of the quinoline HDN experiments are described. The results are compared to those obtained for catalysts used at Wilsonville. The field emission method employed in FIMS is a mild, yet efficient, ionization that exclusively produces molecular ions from most chemical compounds. Thus the mass spectra of complex mixtures are not complicated by the presence of large numbers of peaks associated with molecular fragments. FIMS thus provides molecular profiles of samples. It has been used in the characterization of both petroleum and coal derived-materials. The relative ionization efficiencies of many different classes of organic compounds analyzed by FIMS are very similar, varying by only a factor of two.

37861 Nitrogen base poisoning of NiMo liquefaction catalysts: a kinetic study. Adkins, B.D. (Kentucky Energy Cabinet Lab., Lexington (USA)); Milburn, D.R.; Davis, B.H. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 221-228 (1988). DOE Contract FC22-85PC80009. (CONF-8809273–: Coal liquefaction, Los Angeles, CA, USA, 25-30 Sep 1988).

A mechanistic model has been proposed to explain coking on hydrotreating catalysts from four process configurations of the Wilsonville, AL coal liquefaction pilot plant. This model, which utilizes reversible adsorption of nitrogen bases on acid sites, and irreversible poisoning of these sites by sodium, can explain all of the trends seen in the elemental compositions of the catalysts used in six pilot plant runs spanning four process configurations, two coals and two catalysts. In considering the proposed exchanges, the question of overall rate control must be addressed. A simple kinetic analysis is presented in an attempt to determine whether adsorption or desorption is controlling these exchanges.

37862 Effect of pore structure on catalytic coal liquefaction. Rhee, Y. (Auburn Univ., AL (USA)); Guin, J.A.; Curtis, C.W. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 229-236 (1988). (CONF-8809273–: Coal liquefaction, Los Angeles, CA, USA, 25-30 Sep 1988).

Considerable evidence for pore diffusional limitations in coal liquefaction has been reported in the literature. In this research catalysts having different pore structures were prepared using two methods, impregnation and coextrusion. The pore structures were controlled either by a sintering technique or by using combustible fibers. The initial activity of prepared catalysts was evaluated in coal liquefaction reactions with tetralin solvent. A model describing the

relation between catalyst surface area and catalyst activity was developed by assuming (1) that every pore perfectly communicates and has a cylindrical shape, (2) that the pellet catalyst has a simple bimodal pore size distribution and (3) that a single first-order reaction occurs in the diffusion controlled region. For simplicity, reactant molecular size also was assumed to be uniform.

37863 Spectroscopic study of catalysis by zinc chloride of coal depolymerization. Wang, H.P. (Univ. of Utah, Salt Lake City (USA)); Wann, J.P.; Eyring, E.M. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 259-264 (1988). (CONF-8809273–: Coal liquefaction, Los Angeles, CA, USA, 25-30 Sep 1988).

Diffuse reflectance infrared spectroscopy was used to monitor in situ reactions which ether groups undergo during the depolymerization of $ZnCl_2$-impregnated Wyodak coal at elevated temperatures. Subtraction procedures were used to obtain difference spectra that revealed small changes in IR band intensity between 2000 and 1000 cm^{-1}. Evidence was obtained indicating that the $ZnCl_2$-impregnated coal samples could be depolymerized in an inert argon atmosphere. However, the degree of the cleavage of ether linkages catalyzed by $ZnCl_2$ in an inert atmosphere is about 30% of that in a high pressure hydrogen atmosphere (68 atm). The effect of solvent on impregnation of $ZnCl_2$ in coal samples was also studied. A higher degree of cleavage of what appears to be a phenyl ether linkage was found for $ZnCl_2$-impregnated coal prepared in methanol compared to similar preparations in water and in acetone.

37864 Amphoteric reactions of supercritical water with coal models. Horiuchi, A.K. (Univ. of Colorado, Denver (USA)); Fish, H.T.; Mikita, M.A. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 292-299 (1988). DOE Contract FG22-85PC81544. (CONF-8809273–: Coal liquefaction, Los Angeles, CA, USA, 25-30 Sep 1988).

For the past several years this laboratory has been studying water assisted coal liquefaction. Initial experiments were designed to determine whether water could replace all or part of the donor solvent in coal liquefaction. More recent work has focused upon the chemical reactions of coal models in supercritical water. For the past year efforts have centered upon the study of two distinct coal model compound systems (bibenzyls and benzyl phenyl ethers) with water under liquefaction conditions. This research is intended to further evaluate the chemical role of water above its critical temperature in the conversion of coal to a liquefaction product. Results are discussed.

37865 EPR Study of the catalytic effects of minerals on free radical formation during coal pyrolysis. Ali, M.S. (Texas Christian Univ., Fort Worth (USA)); Graham, W.R.M. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 217-226 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

A systematic in situ study of free radicals in Pittsburgh No. 8, acid treated coal (ATC) as a function of temperature and residence time has been carried out using the electron paramagnetic resonance (EPR) technique at temperatures up to 900 K. The catalytic effects of pyrite, pyrrhotite, calcite, and clays on free radical formation during pyrolysis have been examined.

37866 Time-resolved pyrolysis mass spectrometry of coal: a new tool for mechanistic and kinetic studies. Chakravarty, T. (Univ. of Utah, Salt Lake City (USA)); Meuzelaar, H.L.C.; Windig, W.; Hill, G.R. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 211-216 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

Most coal devolatilization studies so far have focused on the determination of reaction rates for reactions occurring under widely different conditions encountered in liquefaction, gasification, coking or combustion processes. Published rates on more or less comparable coals may differ by several orders of magnitude, especially when obtained at high temperatures (>1000 K) and/or high heating rates (10^2-10^5 K/s). The devolatilization behavior of coal will be determined primarily by the chemical composition of coal and secondly by the experimental conditions. Under properly designed vacuum micropyrolysis experiments working with sufficiently small particles (<50μ diameter), it is possible to avoid mass and heat transport limitations and minimize the secondary reactions. Using premium coal samples from Argonne National Laboratory the chemical composition can be well defined and possibly characterized by major factors such as rank and depositional environment. Recent advances in pyrolysis mass spectrometry (Py-MS), viz, time-resolved Py-MS (TR Py-MS), along with multivariate analysis techniques enable extraction of underlying chemical components from a single experiment; thus reducing the uncertainty due to varying reactions conditions in different experiments. This paper demonstrates the feasibility of obtaining valuable mechanistic and kinetic data using microgram amounts of carefully selected coal samples under properly designed reaction conditions using TR Py-MS techniques in combination with advanced multivariate data analysis methods.

37867 Copper catalyzed low-temperature pyrolysis as a means for upgrading low-rank solid fuels. Stournas, S. (National Technical Univ., Athens, GA (USA)); Papachristos, M.; Kyriakopoulos, G.B. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 227-233 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

Low-rank solid fuels (lignite and peat) are characterized by a high oxygen content of a DAF basis, a large proportion of which belongs to carboxyl and hydroxyl groups. These groups being thermally labile, the oxygen content of low-rank coals can be substantially decreased (and their heat content per unit mass correspondingly increased) by subjecting them to simple pyrolytic treatment. It has been found that the behavior of certain types of lignite and peat is similar to that of simple carboxylic acids, in that the thermal decarboxylation process can be catalyzed by specific metal ions. Thus when lignite and peat, in the presence of small amounts of copper, are pyrolyzed at low temperatures (160°-200° C), they readily undergo decarboxylation and dehydration and their higher heating values on a DAF basis show increases of the order of 30%. When uncatalyzed, these same reactions require temperatures in excess of 300° C.

37868 Pyrolysis of Wilsonville coal liquefaction residues. Leet, W.A. (Amoco Oil Company, Naperville, IL (USA)); Cronauer, D.C. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 234-241 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

Wilsonville coal liquefaction residues including vacuum tower bottoms (VTB), critical solvent deashing (CSD) product resids, and CSD ash concentrates were pyrolyzed via isothermal thermogravimetric analysis. Pyrolysis yields of gas, liquid, and coke were found to be insensitive to temperature over the range of 800-1200°F. The yields of pyrolysis products generated from the CSD resids indicate that the CSD resids represent the more thermally reactive and volatile portions of the VTB. The tendency of such resids to form coke upon pyrolysis correlates with phenolic hydroxyl content. Unusually low gas plus liquid yields for the relatively hydrogen rich ash concentrates correlates with high heteroatom and mineral matter contents. Differences observed in pyrolysis yields for samples from Wilsonville runs made with and without recycle of unconverted coal and mineral matter further characterize the role of such recycle.

37869 Pseudocomponent model for prediction of molecular weight distribution of pyrolysis liquids generated at slow and rapid heating rate reactors. Khan, M.R. (Morgantown Energy Technology Center, WV (USA)); Kumar, K.H. *Energy and Fuels (USA),* 3(3): 312-315 (May-Jun 1989).

A model for prediction of fuel-related properties of pyrolysis liquids derived from coal, oil shale, and tar sand is presented. The bulk hydrocarbon liquid is distributed by using an existing method developed for petroleum fuels into pseudocomponent molecular weights and mole fractions. Comparison of this distribution with experimental field ionization mass spectrometry (FIMS) molecular weight profiles on several liquids indicates good agreement. The results from analyses such as this will serve as input to conventional process simulators with pseudocomponent capability. 9 refs., 6 figs.

37870 Impact of liquefaction solvent composition on hydrogen utilization efficiency. Malhotra, R. (SRI International, Menlo Park, CA (USA)); McMillen, D.F. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 319-324 (1988). DOE Contract FG22-86PC90908. (CONF-8809273--: Coal liquefaction, Los Angeles, CA, USA, 25-30 Sep 1988).

In previous mechanistic work directed at understanding the modes of bond scission available for relevant coal structures, the authors observed experimentally that the selectivity and efficiency with which donatable hydrogen is used to cleave aryl-alkyl linkages in coal surrogates is highly dependent on the degree of hydrogenation of the donor. The observed variations in efficiency were well reproduced by a mechanistic numerical model incorporating the various competing H-transfer processes. The basic trend elaborated by the model is that an increase in the level of polycyclic aromatic hydrocarbon in the solvent can increase the efficiency of H-utilization markedly at a minor expense in H-transfer rate. Conversely, solvents which are very low in the fully aromatic PCAH component tend to transfer hydrogen faster, but do it less discriminately, such that a much smaller fraction of the hydrogen transferred goes to produce hydrogenolysis, and more goes to simple ring hydrogenation. At that time they proposed that this trend in efficiency could have substantial implications for actual coal liquefaction, but they had no obvious examples at hand to cleanly support this assertion. The recent results of Mochida and coworkers provide a very clear illustration of the relevance of their earlier projections. This demonstration of relevance includes the premise on which these conclusions were based, namely that H-transfer-induced bond scission plays a substantial role in coal liquefaction. In this paper they discuss Mochida's results in light of their earlier findings, and elaborate on the interactive effects of the H-donor and acceptor components of liquefaction solvents.

37871 Investigation of liquefaction mechanisms using molecular probes. Bockrath, B.C. (Pittsburgh Energy Technology Center, PA (USA)); Schroeder, K.T.; Smith, M.R. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 325-332 (1988). (CONF-8809273--: Coal liquefaction, Los Angeles, CA, USA, 25-30 Sep 1988).

The mechanisms of coal liquefaction have been investigated using 1,3-dimethylnaphthalene and decalin as molecular probes. These two pure compounds have been added to various mixtures composed of a coal, a liquefaction solvent, and a high molecular weight alkane. In all cases, the amount of the probes added to the reaction mixture of coal, solvent, and alkane is small enough that the probes themselves are unlikely to perturb the reaction chemistry to a measurable degree. In the present application of this approach, it is of particular interest to probe the effect of using petroleum residua as the liquefaction solvent in conjunction with coal. A combination of coal and resid was selected that has previously been used at the Pittsburgh Energy Technology Center for detailed evaluation of coprocessing schemes. The results described below show that the interaction of coal and residua may lead to a reaction environment wherein the exposure of the probes to free radicals is enhanced over that expected based on additive behavior alone. The addition of coal, in particular, also has a very large influence on the selectivity of demethylation of dimethylnaphthalene.

37872 Coal liquefaction: impact of alkyl substitution in naphthalene model solvents. Keogh, R.A. (Kentucky Energy Cabinet Lab., Lexington (USA)); Chawla, B.; Tsai, K.J.; Davis, B.H. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 333-342 (1988). (CONF-8809273--: Coal liquefaction, Los Angeles, CA, USA, 25-30 Sep 1988).

The solvent 1-methylnaphthalene has a unique ability of being able to effect the use of gaseous hydrogen during coal conversion. This unique characteristic is not universal; rather it is exhibited only for about one-third of the eastern and western Kentucky coals examined in this study. With these exceptional coals, 1-methylnaphthalene may be as, and sometimes even more, effective than tetralin in converting coal to pyridine soluble products.

37873 Hydroliquefaction of coal-oil agglomerates. Ha, B.C. (Pittsburgh Energy Technology Center, PA (USA)); Ruether, J.A.; Smith, D.N.; Mima, J.A. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 343-350 (1988). (CONF-8809273--: Coal liquefaction, Los Angeles, CA, USA, 25-30 Sep 1988).

A novel coal hydroliquefaction process has been developed at PETC that employs a low-solvent-to-coal (S/C = 0.35) feed with a water-soluble dispersed catalyst. The effectiveness of liquefaction catalysts, iron and molybdenum, when loaded on the outside surface of coal-oil agglomerates is compared to that of aqueous impregnation. In the presence of 1 wt% iron and 5 vol% hydrogen sulfide, the iron-impregnated coal gave higher conversions than an agglomerated feed. Iron catalyst must be in intimate contact with individual coal particles for highest reactivity. Aqueous impregnation is, therefore, the best catalyst-loading method for dispersed iron. In the presence of 0.1 wt% molybdenum, higher conversions were, however, achieved with the coal-oil agglomerates than with molybdenum-impregnated coal. Oil agglomeration of feed coal eliminated the need for impregnation of molybdenum catalyst on the coal to achieve high conversions at low solvent-to-coal ratio of 0.35. In the absence of catalyst, higher conversions were also achieved with coal-oil agglomerates compared to a simple mixture of coal and oil at S/C = 0.35. The improved reactivity of agglomerates is thought to be due to the complete wetting of individual coal particles by binder oil, a hydrogen donor solvent, which was effected during the oil agglomeration step.

37874 High liquid yields from bituminous coal via hydropyrolysis with dispersed catalysts. Snape, C.E. (British Coal, Cheltenham (England)); Bolton, C.; Dosch, R.G.; Stephens, H.P. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 351-356 (1988). DOE Contract AC04-76DP00789. (CONF-8809273--: Coal liquefaction, Los Angeles, CA, USA, 25-30 Sep 1988).

In this paper the authors report the results of catalytic hydropyrolysis experiments in which greater than 60% daf coal basis yields of tar are produced with weight ratios of tar to gases up to 80% higher than observed in an uncatalyzed reaction. The work has also shown that dispersed sulfided molybdenum and hydrous titanium oxide (HTO) catalysts coated directly on the coal are superior to Lewis acids and alumina supported hydrogenation catalysts in terms of tar yields achieved and reduction of the amount of light hydrocarbon gases produced. In addition, they have performed two-stage hydropyrolysis tests which demonstrate that the tar produced is readily upgraded.

37875 Hydrodenitrogenation of quinoline and coal using transition metal sulfides. Curtis, C.W. (Auburn Univ., AL (USA)); Cahela, D.R. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 315-324 (1988). (CONF-870802--: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

This study investigates the effectiveness of unsupported, precipitated transition metal sulfides as HYD and HDN catalysts in both a quinoline system and a coal liquefaction system. The transition metal sulfides of moderate surface areas were produced by a method developed by Chianelli and Dines in the late 1970's. These materials crystallize in weakly interacting layers which allow for ready intercalation of appropriate species. A number of different transition metal sulfides have been tested for HDS activity using dibenzothiophene and are good candidates for hydrodenitrogenation (HDN) studies. The degree of HYD and HDN of quinoline and the reaction products from coal liquefaction were determined using precipitated transition metal sulfides and compared to commercial transition metal sulfides, commercial hydrotreating catalysts such as $CoMo/Al_2O_3$ and $NiMo/Al_2O_3$, and platinum containing catalysts such as Pt/SiO_2 and PtS_2.

37876 Causes of catalyst deactivation during quinoline hydrodenitrogenation. Stohl, F.V. (Sandia National Laboratories Albuquerque, NM (USA)). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 325-331 (1988). DOE Contract AC04-76DP00789. (CONF-870802--: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

The current work involves determining the causes of deactivation due to hydrotreating pyridinic compounds. Quinoline was chosen as the model compound for this study because it represents a type of

nitrogen compound present in coal-derived materials, and a hydrodenitrogenation (HDN) reaction network has been proposed for this compound. In the proposed reaction scheme, at low temperatures, quinoline is hydrogenated to 1,2,3,4-tetrahydroquinoline (PyTHQ). PyTHQ is cracked to o-propylaniline (OPA), and then the nitrogen is removed, as ammonia, to give propylbennzene (PBz). At high temperatures, the hydrogenation of quinoline to 5,6,7,8-tetrahydroquinoline (BzTHQ) also becomes important. BzTHQ is further hydrogenated to decahydroquinoline (DHQ) which is then cracked and denitrogenated to yield mostly propylcyclohexane (PCH). TyTHQ can also be hydrogenated to DHQ and OPA can also be hydrogenated and denitrogenated to PCH. The initial work reported here on the causes of deactivation due to hydrogenating quinoline will cover the impact of process conditions on deactivation and the determination of the effects of the reaction scheme intermediates and products on deactivation.

37877 **Hydrotreatment effects on Wilsonville coal liquids: computer-assisted evaluation of multisource analytical data.** Taghizadeh, K. (Kentucky Energy Cabinet Laboratory, Lexington (USA)); Hardy, R.; Keogh, R.; Goodman, J.; Davis, B.; Meuzelaar, H.L.C. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 332-341 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

As reported earlier, monitoring time-dependent changes in Wilsonville coal-derived liquid (CDL) streams by means of computer-assisted direct mass spectrometry (MS) techniques enables detection of process related trends in the relative concentration of CDL components. Notwithstanding the potentially high information yield of this MS procedure, additional data is required for unambiguous identification and interpretation of some of the more complex components or trends. In fact, the CDL's produced by the Wilsonville pilot plant are routinely analyzed by an extensive array of conventional tests, including elemental analysis and solubility classes, as well as by advanced chromatographic and/or spectroscopic techniques, e.g., proton nuclear magnetic resonance spectroscopy (NMR) and carbon-13 NMR. Unfortunately, the sheer volume of the data produced by this broad array of tests during a 2 to 3 month run makes it very difficult to discern some of the more interesting trends and effects. In the experiments reported here computerized multivariate analysis techniques such as factor, discriminant and canonical correlation analysis, were used to remove redundant data or experimental noise and to highlight relevant components and trends.

37878 **Conversion of tetralin to naphthalene during coal liquefaction: a coal rank phenomenon?.** Chawla, B. (Kentucky Energy Cabinet Laboratory, Lexington (USA)); Keogh, R.; Davis, B.H. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 342-351 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

Since coal conversion, in the presence of tetralin (a donor solvent), is believed to be a coal rank phenomenon, it seemed worthwhile to determine the role of rank upon conversion of tetralin (T) to naphthalene (N) during coal liquefactions at 385°, 427° and 445°C. The THF soluble fractions, containing T and N, were analyzed using a high performance liquid chromatographic technique. The T/N ratios, for eight coal samples of different ranks, showed a direct relationship between the coal rank and the T/N ratio. The conversion of tetralin to naphthalene was lowest for the highest rank coal, and vice versa. The T/N ratio versus rank relationship was obtained for reaction times ranging from 5 to 65 minutes.

37879 **Organic/mineral interaction in coal liquefaction bottoms.** Leet, W.A. (Amoco Oil Corp., Naperville, IL (USA)); Lee, F.S.C.; Gandy, R.; Cronauer, D.C. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 352-358 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

Characterization of the organic/mineral matter interactions is central to the problem of solid/liquid separation in the liquefaction of coal. Samples of the vacuum tower bottoms from the liquefaction of Illinois No. 6 coal in the Wilsonville pilot plant have been studied. The techniques include various analyses such as elemental, solvent extraction, STEM, FTIR, XPS, XRD, and XRF. Surface active oxygenates associated with organic/mineral matter interaction appear to consist of both phenolics and carboxylates. The observed characteristics of the organic/mineral interactions were affected by the recycle of mineral matter and unconverted coal as part of the liquefaction feed solvent.

37880 **Catalyzed reactions of alkylaromatic hydrocarbons dissolved in supercritical fluids.** Knopf, F.C. (Louisiana State Univ., Baton Rouge (USA)); Pang, T.H.; Dooley, K.M. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 359-367 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

Partial oxidations of alkylaromatic compounds occur at below 600K through catalytic mechanisms that are partly free radical in nature. These side chain oxidations and hydroxylations are usually catalyzed homogeneously by transition metal complexes or mixtures of metal salts with redox capabilities. Compounds of Co, Fe, and Mn are examples. An alternative to liquid-phase processes is to use a supercritical fluid (SCF) phase to contact solid analogs of the homogeneous catalysts. Considering the above example of toluene oxidation, the use of an SCF phase would result in a homogeneous mixture and the removal of solubility limitations on O_2. SCF mixtures have better mass transfer characteristics than typical liquids, and rapid reaction quenching of highly exothermic oxidations is possible by a pressure letdown from the SC region. A stages pressure letdown engenders another benefit, that of fractionation of reactants and products, eliminating the need for more complex downstream separation. Therefore it appears possible to exploit the capabilities of a SC mixture to provide a reaction medium for an entire class of what would normally be liquid phase oxidations. We are currently examining such catalytic oxidations in SCF-CO_2 for upgrading model coal liquid compounds that result from SCF extraction or flash hydropyrolysis processes.

37881 **Hydrogen transfer cycle for coal liquefaction – process implications.** Stephens, H.P. (Sandia National Laboratories, Albuquerque, NM (USA)); Kottenstette, R.J. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 377-384 (1988). DOE Contract AC04-76DP00789. (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

Direct liquefaction of coal involves the conversion of a hydrogen-poor solid to a liquid richer in hydrogen by a complex set of bond ruptures and a hydrogen transfer reactions. This paper reports a portion of a continuing effort to understand the utilization of hydrogen in direct liquefaction by tracing the transfer of hydrogen from the gas phase to polynuclear aromatic hydrocarbon (PAH) solvent components, and from these donor components to coal. In this portion of the effort, experiments were performed to monitor the dehydrogenation of hydroaromatic components of a coal-derived solvent that results form donation of hydrogen to coal.

37882 **Coal desulfurization by photooxidation.** Mathur, V.K. (Univ. of New Hampshire, Durham (USA)); Govindarajan, U. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(4): 313-317 (1987). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA (USA), 30 Aug - 4 sep 1987).

Oxidative desulfurization of coal has been studied by several workers. These methods primarily involve selective oxidation of organic sulfur to sulfoxide and sulfones, followed by thermal decomposition of the oxidation product. In this investigation, photooxidation of sulfur functionalities in coal is studied. Finely divided coal, suspended in a solvent, is exposed to radiations of wavelength 300-600 nm using a xenon mercury lamp. The coal sample, is next subjected to hydrolysis to remove the oxidized sulfur from the coal matrix. It is observed that coal desulfurization increased by 7.4%, 3.4%, and 23.7% when coal was photooxidized prior to hydrolysis by water, hydrochloric acid and sodium hydroxide, respectively. Sulfur removed by this technique as sulfonic, sulfurous or sulfuric acid or their salts would be mostly organic in nature.

37883 **Correlation of benzene production with soot yield determined from fuel pyrolyses.** Kern, R.D. (Univ. of New Orleans,

LA (USA)); Wu, C.H.; Yong, J.N.; Pamidimukkala, K.M.; Singh, H.J. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 456-466 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

The rate of production of soot in pyrolytic reaction systems has been studied in shock tubes using a variety of non-intrusive analytical techniques; laser extinction (LEX), static analysis of the product distribution from single pulse shock tubes (SPST), and dynamic analysis of the reflected shock zone by time-of-flight mass spectrometry (TOF). The data reduction process often involves measurement of a changing bulk quantity; e.g., attenuation of a He-Ne laser beam due to absorption by high molecular weight gas phase species and discrete soot particles via LEX or deficiencies in the carbon atom mass balance via SPST or TOF. The concentrations of the various polycyclic hydrocarbons formed in the pre-particle soot chemistry phase are extremely low and are below the detectability limit of the TOF technique which is about 10^{-10} mol cm^{-3}. The non-detected hydrocarbons constitute the missing mass. The ultimate goal of the work in this area is to write a complete chemical mechanism for soot formation. The effort herein is to develop a correlation between a readily observable molecular species whose presence is diagnostic of subsequent soot formation and the bulk observables of laser extinction and mass balance deficiency.

37884 Molecular dissociation of vinylacetylene and its implication for acetylene pyrolysis. Kiefer, J.H. (Univ. of Illinois, Chicago (USA)); Mitchell, K.I. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 474-479 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

In a collaboration with R. D. Kern we have reinvestigated the C_4H_4 decomposition at very high temperatures (1500-2500K) where the unimolecular dissociation should dominate, using laser-schlieren (LS) and time-of-flight (TOP) mass spectroscopy techniques on shock waves. Here we present a brief reiteration of the C_4H_4 results together with their implications for the C_2H_2 pyrolysis, implications which have led to the proposal of a new mechanism for this reaction.

0106 Properties

Refer also to citation(s) 37826, 37842, 37843, 37848, 37855, 37863, 37869, 37877, 37927, 38909, 38912

37885 (CONF-890582–2) **Aliphatic structural elements of bituminous coals.** Stock, L.M.; Choi, Chol-yoo; Muntean, J.V.; Wang, Shih-Hsien. Argonne National Lab., IL (USA). 1989. 14p. Sponsored by DOE Energy Research. DOE Contract W-31109-ENG-38. From Biological processing of coal and coal-derived substances; Palo Alto, CA (USA); 16-17 May 1989. Order Number DE89015161/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Recent research on the aliphatic structural elements of bituminous coals is discussed in this presentation. 6 refs., 1 fig., 3 tabs.

37886 (DGMK–418-2) **Analytical methods for metals in coal and related products.** Riepe, W. Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.); Bergbau-Forschung G.m.b.H. Forschungsinstitut des Steinkohlenbergbauvereins, Essen (Germany, F.R.). Jan 1989. 36p. (In German). Available from Copy held by UB/TIB Hannover.

The literature of analytical methods for metals in coal and related products is critically reviewed. Above all the metals V, Ni, Cd, As, Hg, Co, Cu, Mn and Sb are concerned. The methods are compared and listed according to their efficiency. (orig.) With 2 tabs., 167 refs.

37887 (DOE/ER/13481–1) **Reduction of coal, coal oils and functionalized aromatic compounds derived from coal by calcium in amines: Final report, January 1, 1986–March 31, 1989.** Benkeser, R.A. Purdue Research Foundation, Lafayette, IN (USA). Jun 1989. 14p. Sponsored by DOE Energy Research. DOE Contract FG02-86ER13481. Order Number DE89014556/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This quarter it was shown that epoxide rings are opened by calcium in ethylenediamine just as readily as by lithium in ethylenediamine. The reduction of five-membered ring heterocycles containing fused benzene rings was very successful. A total of seven of these was reduced. Indole could be reduced in one step to 4,5,6,7-tetrahydroindole in good yield. The latter compound is now commercially available as a result of our finding. Eight methylated benzoic acids were reduced by calcium in ethylenediamine to Birch products. No additional proton source was necessary to realize good yields of product. Trapping experiments with methyl iodide and ethyl bromide showed conclusively that anionic calcium species were present just prior to hydrolysis. The benzoic acid reductions were extended to include phenylacetic acid, α-methylphenylacetic acid and α,α-dimethylphenylacetic acid. In each case ring reduction occurred, but the products were rather complicated mixtures. While these reductions were not important from a synthetic viewpoint, they did provide considerable insight into the mechanism of calcium-amine reductions.

37888 Sample preparation for, and current status of, the Argonne premium coal sample program. Vorres, K.S. (Argonne National Lab., IL (USA)). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 1-6 (1988). DOE Contract W-31-109-ENG-38. (CONF-8809161–: Symposium on research with Argonne premium coal samples, Los Angeles, CA, USA, 25-30 Sep 1988).

The Argonne Premium Coal Sample Program includes eight coals (Upper Freeport, Wyodak-Anderson, Illinois #6, Pittsburgh, Pocahontas #3, Utah Blind Canyon, Lewiston-Stockton and Beulah-Zap seams) chosen to provide a range of chemical composition, including sulfur content, maceral content and geographic distribution. One of the purpose is to provide a set of pristine samples for comparison and correlation. They have been collected in ton-sized batches and processed to provide a minimal exposure to oxygen, thoroughly mixed, and packaged in borosilicate glass ampoules containing either 5 grams of −100 mesh or 10 grams of −20 mesh material. This material has been analyzed by a number of laboratories, including a round robin with Commercial Testing and Engineering Co. Further data are being added to an analytical data base as they become available. Over 190 shipments have been made to over 110 different users. Research is currently being carried out in almost every area of coal science with these samples.

37889 Surface and pore properties of ANL and PETC coals. Bartholomew, C.H. (Brigham Young Univ., Provo, UT (USA)); White, W.E.; Thornock, D.; Wells, W.F.; Hecker, W.C.; Smoot, L.D.; Smith, D.M.; Williams, F.L. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 24-31 (1988). (CONF-8809161–: Symposium on research with Argonne premium coal samples, Los Angeles, CA, USA, 25-30 Sep 1988).

Surface areas, pore volumes, pore size distribution, and solid densities were measured for three ANL coals (Pittsburgh No. 8, Wyodak, and Beulah Zap Lignite), two PETC coals (Lower Wilcox, and Dietz) and a Utah Scofield coal and for chars derived from these coals. Surface areas were measured using nitrogen and carbon dioxide adsorptions; pore volumes were determined using nitrogen adsorption, mercury porosimetry, and NMR spin-lattice relaxation measurements of samples saturated with water. Solid densities were obtained using helium displacement. The results indicate that chars have larger surface areas and pores relative to coals; large fractions of the internal surfaces of coals are not penetrated by nitrogen molecules but are penetrated by carbon dioxide suggesting that the pores are mostly smaller than 1 nm.

37890 EPR study of pore accessibility in Argonne premium coal samples. Cooray, L.S. (Univ. of Alabama, Tuscaloosa (USA)); Kispert, L.D.; Wuu, S.K. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 32-37 (1988). DOE Contract FG22-86PC90502. (CONF-8809161–: Symposium on research with Argonne premium coal samples, Los Angeles, CA, USA, 25-30 Sep 1988).

This study reports a spin probe - EPR study of pore size distribution, the basic/acidic reactive site distribution, hydrogen bonding site distribution and the effect of a swelling solvent on Blind Canyon, Pittsburgh #8 and Illinois #6 from the Argonne premium coal sample program and Illinois #6 (PSOC-1354) and New Mexico (PSOC-311) from the Penn State Coal Sample Bank at Penn State University. The spin probe - EPR method showed that as the swelling solvent was changed from benzene to pyridine, the number of spherical

pores in Pittsburgh #8 decreased while the number of elongated pores of distinct size increased sharply in agreement with previously reported SANS studies. Reasonable agreement was found with independent studies on the average size distribution and the presence of acid character in the accessible pores of Illinois #6. Comparison between NMR data and the pore distribution pattern deduced by the spin-probe EPR method indicates that toluene swelled PSOC-1354 has more bottleneck pores with a radius of less than 5 nm which are not accessible to toluene than PSOC-311.

37891 Double cross polarization ^{13}C-NMR experiment in solid fossil fuel structure analysis. Hagaman, E.W. (Oak Ridge National Lab., TN (USA)); Woody, M.C. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 48-49 (1988). DOE Contract AC05-84OR21400. (CONF-8809161–: Symposium on research with Argonne premium coal samples, Los Angeles, CA, USA, 25-30 Sep 1988).

The Double Cross Polarization ^{13}C-MAS/NMR experiment has been used to derive a new operational classification of solid fossil fuels based on chemical reactivity. The method requires labeling reactive sites in the organic matrix with a magnetically active isotope not present in the precursor material, and using the local, isolated dipole-dipole interaction between this nucleus and nearby ^{13}C nuclei to detect via cross polarization the carbon centers in the vicinity of the label. The technique is a marriage of chemistry and spectroscopy and the information content of the DCP spectra is defined by both partners. ^{1}H-^{13}C-^{31}P DCP/MAS ^{13}C-NMR spectroscopy has been used to statistically describe phenolic ortho-substitution patterns of coals via their aryl phosphinate or phosphate derivatives. In these applications of DCP NMR the new, detailed structure and/or reactivity information is realized by detection of carbon resonances one or more bonds removed from the reaction center, but in a volume element of intramolecular dimensions. To the extent that intermolecular contributions to the spectrum are detected, and not recognized as such, the structure/reactivity correlation is weakened. Direct substitution of phosphorus on the aromatic rings in the organic matrix of the coal is not readily accomplished. This environment potentially can be labeled with fluorine in a selective fashion using newly developed reagents. The possibility of determining the changes in average ring substitution patterns as a function of chemical treatment or coal diagenesis emerges. Recent developments in the field of DCP ^{13}C NMR are presented.

37892 Solid state ^{13}C relaxation studies of coals. Botto, R.E. (Argonne National Lab., IL (USA)); Axelson, D.E. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 50-57 (1988). DOE Contract W-31-109-ENG-38. (CONF-8809161–: Symposium on research with Argonne premium coal samples, Los Angeles, CA, USA, 25-30 Sep 1988).

Despite many studies of coal and related fossil fuels, no attempts have been made to systematically correlate changes in the solid state ^{13}C-NMR parameters as a function of static field strength. In particular, questions arise regarding differences in spectral resolution and relaxation parameters. While discrimination among the complex structural components of fossil fuels can be based on relaxation time differences, this also necessitates a more intensive study of static field-strength effects if a more complete understanding of coal structure is to be gained. Spectral resolution is virtually invariant with rank over the static frequency range of 25 to 50 MHz. Although correlations between relaxation times and rank-related parameters are clearly observed at both field strengths, they probably arise from both fundamental changes in coal structure (with increasing degree of coalification) and systematic variations in the nature and extent of paramagnetic species present. The paramagnetic species themselves may represent a combination of stable organic free radicals present in large aromatic ring systems and a distribution of inorganic species, presumably which are chelated to oxygen-rich organic structures (particularly in the low-rank coals). The presence of a maximum in the spin-lattice relaxation time at both fields at 85%C probably reflects these competing interactions. For the raw, untreated coals there are systematic differences in relaxation times with rank that may be of use in relaxation discrimination experiments.

37893 Determination of the hydroxyl and carboxylic acid content of coal macerals using combined chemical and spectroscopic techniques. Choi, C. (Argonne National Lab., IL (USA)); Muntean, J.V.; Thompson, A.R. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 58-66 (1988). DOE Contract W-31-109-ENG-38. (CONF-8809161–: Symposium on research with Argonne premium coal samples, Los Angeles, CA, USA, 25-30 Sep 1988).

Macerals were separated from two high volatile bituminous coals obtained from the Argonne Premium Coal Sample Program and one high volatile bituminous coal from the Pennsylvania State University Coal Sample Bank. A preliminary survey of the nature of these macerals using chemical and spectroscopic techniques are reported. Alkylation using ^{13}C enriched methyl iodide followed by solid ^{13}C NMR analysis were used to determine the concentrations of acidic OH and CH sites in these macerals. The relative quantities of various types of methyl ethers and methyl esters were also estimated from the NMR spectra.

37894 Simultaneous thermogravimetric and mass spectrometric observations on vacuum pyrolysis of Argonne PCSP coals. Yun, Y. (Univ. of Utah, Salt Lake City (USA)); Meuzelaar, H.L.C. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 75-84 (1988). (CONF-8809161–: Symposium on research with Argonne premium coal samples, Los Angeles, CA, USA, 25-30 Sep 1988).

The most serious limitations of many coal gasification and liquefaction models are due to the lack of reliable char and total volatiles yields data, of accurate kinetic parameters, and of reliable data on the composition of the total volatiles in the initial devolatilization step. Consequently, a vacuum thermogravimetry/mass spectrometry (TG/MS) system consisting of a Mettler TA1 Thermoanalyzer and a Finnigan MAT 3200 quadrupole mass filter was built to obtain accurate quantitative and qualitative data on coal devolatilization processes at heating rates in the 10^{-2}-10^{0} K/s range. Hundreds of mass spectra can be obtained during a single TG run, thereby providing detailed information about the concentration of various devolatilization products as a function of temperature while continuously recording the sample weight loss. Moreover, factor analysis-based methods enable deconvolution of overlapping trends and numerical extraction of chemical component spectra. TG/MS results on four Argonne PSCP coals are discussed.

37895 Characterization of the Argonne premium coal samples by pyrolysis high resolution mass spectrometry. Winans, R.E. (Argonne National Lab., IL (USA)); McBeth, R.L.; Neill, P.H. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 85-90 (1988). DOE Contract W-31-109-ENG-38. (CONF-8809161–: Symposium on research with Argonne premium coal samples, Los Angeles, CA, USA, 25-30 Sep 1988).

The complete set of Argonne Premium Coal Samples have been characterized using Pyrolysis High Resolution Mass Spectrometry (PyHRMS). A major objective in the study is to examine differences in the heteroatom (oxygen, sulfur and nitrogen) containing molecules as a function of rank of the coal. Operating in the high resolution mode makes it possible to directly separate these species from each other and from the hydrocarbon molecules. In addition, many molecules, which can not be observed with gas chromatography by virtue of their size or polarity, can be observed with this method. The authors have applied PyHRMS to characterization of separated coal macerals and coal degradation products. There are many papers on low resolution PyMS applied to coals and one applied to these premium coals. The PyMS approach can provide very detailed information on the molecules which are released in vacuum pyrolysis, however the probability of secondary reactions is a consideration and all interpretation must be made with this fact in mind. This approach yields more specific molecular data than any other method. A problem with low resolution PyMS is that in many if not most cases there may be several ions present with the same nominal mass but with different chemical compositions. This problem is eliminated by using a high resolution spectrometer which may scan more slowly, but will resolve peaks which overlapped at lower resolution and yield more information.

37896 Spectral emission characteristics of size-graded coal particles. Fletcher, T.H. (Sandia National Laboratories, Livermore,

CA (USA)); Baxter, L.L.; Ottesen, D.K. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 42-50 (1988). (CONF-870802--: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

The spectral emission characteristics of coal are examined using Fourier transform infrared emission spectroscopy. The data were collected from a single layer of stationary, narrowly size-classified samples of coal and graphite placed on a heated NaCl window. Sample temperatures ranged from 120 to 200°C. FTIR data were collected at wavelengths between 2.2 and 17 μm between 4500 and 580 cm^{-1}. Particle sizes ranged from 40 to 120 μm and coal rank ranged from lignite to bituminous. The focus of this work is to evaluate the effects of the nongray emission characteristics of coal on heat transfer calculations and pyrometry measurements. Chemical functional groups responsible for the features of the spectral emission are identified but not discussed. Well characterized special features from coal samples are observed and discussed. The intensity of spectral peaks due to chemical functional groups in coal are analyzed as a function of particle size and extent of reaction. The impact of spectral irregularities on pyrometry measurements and heat transfer calculations is evaluated. Featureless regions of the infrared emission spectra of coal are also analyzed and compared to graybody behavior. Reliability of pyrometry measurements in these regions and effective emissivities of coal particles for heat transfer calculations are discussed.

37897 Effects of particle size and air flow rates on the runaway temperature of bituminous coal at 290K < T < 700K. Malhotro, V.M. (Southern Illinois Univ., Carbondale (USA)); Crelling, J.C. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(4): 70-81 (1987). (CONF-870802--: 194. American Chemical Society national meeting, New Orleans, LA (USA), 30 Aug - 4 sep 1987).

Spontaneous ignition and combustion of coal are major problems not only for actual mining of coal but also for its transportation and for industrial users. Most coals are prone to spontaneous combustion, but their susceptibility to ignition increases as the coal rank decreases. However, there are many anomalies to this straight rank order susceptibility. Chamberlain and Hall have in fact, pointed out that some higher rank coals may be more susceptible to spontaneous ignition than lower rank coals. The causes and mechanisms of spontaneous ignition are enigmatic because exceptions exist for every previously-suggested, single cause. Several models have been advanced to describe spontaneous heating, however. Among these are coal rank, electrostatic effects, geological factors, temperature, microbial ignition, the reduction in reactivity due to deterioration, air flow rates, particle size, pyrite content, porosity and water wetting of coal. The purpose of this research was to examine the factors which may contribute to spontaneous ignition of ultrafine (particle size < 250 μm) bituminous coals and maceral enriched fractions under storage, air flow and/or dense phase pneumatic conditions and to understand physical interactions and chemical reactions pathways which may lead to spontaneous ignition of bituminous coals. We have initiated spontaneous ignition, FTIR, DSC, TGA and EPR measurements to accumulate data which can be used to propose mathematical models for spontaneous ignition of stored and pneumatically conveyed coals. In this report, we present our preliminary results on a high-volatile bituminous coal subjected to ignition temperature and FTIR measurements.

37898 Determination of phenolic structures in low rank coals: elucidation of transformation processes of lignin at the early stage of coalification. Hayatsu, R. (Argonne National Lab., IL (USA)); McBeth, R.L.; Scott, R.G.; Winans, R.E. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 107-112 (1988). DOE Contract W-31-109-ENG-38. (CONF-8809161--: Symposium on research with Argonne premium coal samples, Los Angeles, CA, USA, 25-30 Sep 1988).

Because lignin is considered to be a major precursor of coal vitrinite, chemical alteration studies of lignin structure are important for elucidating coalification processes as well as for understanding the chemical structure of vitrinite. Many investigators have attempted to elucidate the chemical processes in the coalification lignin. For example, Wayman et al have reported that a 100-million-year-old conifer consists of lignin-like material which is about one-third demethylated. Extensive cleavage of lignin ether linkages was also observed. Recently, based on ^{13}C NMR study, Hatcher has concluded that the defunctionalization reactions of lignin-derived aromatic structures occur sequentially during coalification. A similar pathway has been suggested by Wilson. From a comparative NMR study of (β-^{13}C) lignin and its coalified products, Botto has suggested that transformation of lignin is initiated by the heterolytic bond cleavage of labile β-aryl ether groups. The present study continues the investigation of transformation processes of plant organic material to coal during early stages of coalification. To understand alteration of phenolic structures in lignin, and natural and synthetic coals have been characterized by using two-step depolymerization procedure of alkaline hydrolysis followed by silver oxide oxidation. In parallel experiments, lignin model compounds and a polymer have been transformed using thermal catalytic reaction conditions that mimic natural catagenetic metamorphism.

37899 Efficient, large scale separation of coal macerals. Dyrkacz, G.R. (Argonne National Lab., IL (USA)); Bloomquist, C.A.A. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 128-135 (1988). DOE Contract W-31-109-ENG-38. (CONF-8809161--: Symposium on research with Argonne premium coal samples, Los Angeles, CA, USA, 25-30 Sep 1988).

The authors believe that the separation of macerals by continuous flow centrifugation offers a simple technique for the large scale separation of macerals. With relatively little cost (~ $10K), it provides an opportunity for obtaining quite pure maceral fractions. Although they have not completely worked out all the nuances of this separation system, they believe that the problems they have indicated can be minimized to pose only minor inconvenience. It cannot be said that this system completely bypasses the disagreeable tedium or time involved in separating macerals, nor will it by itself overcome the mental inertia required to make maceral separation an accepted necessary fact in fundamental coal science. However, they find their particular brand of continuous flow centrifugation is considerably faster than sink/float separation, can provide a good quality product with even one separation cycle, and permits the handling of more material than a conventional sink/float centrifuge separation.

37900 Importance of diphenylmethane-like structural units in an Argonne premium coal sample. Chambers, R.R. Jr. (Oak Ridge National Lab., TN (USA)); Hagaman, E.W.; Woody, M.C. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 141-144 (1988). DOE Contract AC05-84OR21400. (CONF-8809161--: Symposium on research with Argonne premium coal samples, Los Angeles, CA, USA, 25-30 Sep 1988).

The development and application of chemical and spectroscopic techniques for the purpose of evaluating the acidic O-H and C-H sites in coal has received much attention recently. This approach for characterizing the acidic C-H bonds in coal is to treat O-methyl coal with a series of indicator bases, BLi, followed by methylation with C-13,14 double labelled methyl iodide. By varying the identity of BLi, and thus the pK_a of the conjugate acid BH, it is possible to evaluate the number of C-H bonds as a function of Pk_a. The bases they have used thus far, 9-phenylfluorenyllithium (pK_a, 18.5), fluorenyllithium (pK_a, 22) and tritylithium (pK_a, 31), have allowed them to evaluate the distribution of acidic C-H sites within the three pK_a ranges: $12 < pK_a \leq 18.5$, $18.5 < pK^a \leq 22$, and $22 < pK_a \leq 31$. The application of this approach to two bituminous coals, namely Illinois No. 6 hvCb and PSOC 1197 1vb, led to the discovery of a significant concentration of acidic C-H sites with $18.5 < pK_a \leq 22$ which was interpreted as evidence for fluorene-like structural units in coal. This approach to coal structure analysis is limited to the evaluation of acidic C-H sites with $pK_a \leq 31$. Furthermore, it was shown that $PhCH_2Ph$ (pK_a, 33), the prototypical diarylmethane, is not alkylated to a significant extent upon treatment with tritylithium and methyl iodide. For these reasons, they have developed approaches for the evaluation of acidic C-H sites with $31 < pK_a \leq 33$. In this article, they illustrate these approaches using Upper Freeport mvb (APCS number 1) as the coal.

37901 Relationship between char reactivity and physical and chemical structural features. Best, P.E. (Advanced Fuel Research, Inc., East Hartford, CT (USA)); Solomon, P.R.; Serio, M.A.; Suuberg, E.M.; Mott, W.R. Jr.; Bassilakis, R. *Preprints of Papers,*

American Chemical Society, Division of Fuel Chemistry (USA), 32(4): 138-146 (1987). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA (USA), 30 Aug - 4 sep 1987).

This study focuses on correlations observed between char reactivity, on the one hand, and char resistivity and structural properties on the other. It is the continuation of a study reported recently on the relationship between char reactivity and pyrolysis conditions. There, it was found, as others have observed before, that for most coals, reactivity decreases with increasing degree of pyrolysis. As pyrolysis progresses a number of changes occur in the char: hydrogen and oxygen content decrease, a greater degree of order is brought about and changes occur in the sample shape, pore size distribution and surface area. With so many factors varying, the observation of a correlation between char reactivity and one factor need not imply a cause and effect relationship between the two. The traditional way to deduce cause-and-effect is to vary only one factor at a time, and observe its effect on the measurement. This is not readily done for chars. The result is that the research in char reactivity has established trends, but not a quantitative theory. In this work, chars have been characterized with respect to reactivity, surface area, heteroatom content, ash content, x-ray diffraction, and resistivity. The char characteristics have been correlated with coal rank, coal mineral content, and the heating rate and final temperature used for char preparations. The paper presents a summary of the observed trends.

37902 Non-magic angle spinning NMR - an approach to determine the chemical shift tensors in char particles. Sethi, N.K. (Univ. of Utah, Salt Lake City (USA)); Pugmire, R.J.; Grant, D.M. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(4): 155-167 (1987). DOE Contract FG02-86ER13510. (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA (USA), 30 Aug - 4 sep 1987).

Carbon-13 NMR spectroscopy has been widely accepted as a major analytical technique for studying fossil fuels. Magic angle spinning (MAS) experiments produce narrow lines in solids but valuable structural information is lost; i.e., the chemical shift anisotropy (CSA) which is a manifestation of the three-dimensional shielding of the nucleus by the surrounding electrons. The CSA is a second rank tensor having three principal elements σ_{11}, σ_{22}, and σ_{33} characterized by unique resonance frequencies. These three tensor components taken together with the isotropic shielding value (the MAS value which is the average of the three tensor components) provide valuable data regarding the local electronic environment. The tensor can be obtained from the ^{13}C NMR spectrum of a finely powdered sample and the tensor elements are extracted by analysis of the line shape. This technique provides not only tensor components but population values as well. Only for isolated carbons, or for simple compounds where break-points in the powder pattern are discernible, is it possible to obtain unique fits of the line shape. Tensor information can be extracted by other techniques such as analysis of the spinning side bands from slow spinning MAS experiments and variable angle sample spinning (VASS). In this study we have used the static and VASS methods to study pertinent model compounds and have used these data as a guide to analyze line shapes and extract CSA tensor values and population as well as coals. The experimental techniques are applicable to chars as well as coals. The data permit us to estimate the size of the polycondensed aromatic structure that is the main structural component in chars. The aromatic structure of coal chars should provide valuable information regarding their reactivity.

37903 Correlation of bituminous coal hydroliquefaction activation energy with fundamental coal chemical properties. Shin, S.C. (Colorado School of Mines, Golden (USA)); Baldwin, R.M.; Miller, R.L. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 33(3): 265-282 (1988). (CONF-8809273–: Coal liquefaction, Los Angeles, CA, USA, 25-30 Sep 1988).

The rate and extent of direct coal hydroliquefaction for 5 bituminous coals from the Argonne Premium Sample Bank have been measured. Data were obtained in batch microautoclave tubing bomb reactors at three temperatures (375, 400, 425°C) and 5 residence times (3, 5, 10, 15, 40 minutes) in 1-methylnaphthalene vehicle under a hydrogen blanket. Data on rate of conversion of coal to THF and toluene solubles were modeled with a simple reversible rate expression, and activation energies for conversion to each solvent solubility class determined. Data on carbon and proton distribution in the coals were obtained by ^{1}H-NMR (Combined Rotational and Multiple Pulse Spectroscopy) and ^{13}C-NMR (CPMAS/Dipolar Dephasing). A strong correlation of activation energy with the aliphatic hydrogen content of the coal was found for conversion to THF solubles. Toluene solubles activation energies were found to be highly correlated ($R^2 > 90\%$) with total oxygen, and protonated aliphatic carbon. ^{13}C-NMR data indicated a high degree of correlation between protonated aliphatic carbon and total oxygen for only the bituminous coals from the Argonne suite, suggesting the importance of etheric oxygen in crosslinking structures for determination of bituminous coal reactivity.

37904 Novel application of ^{31}P NMR spectroscopy to the analysis of organic groups containing -OH, -NH and -SH functionalities in coal extracts and condensates. Wroblewski, A.E. (Iowa State Univ., Ames (USA)); Markuszewski, R.; Verkade, J.G. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 202-210 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

Over one hundred model organic compound including phenols, aliphatic alcohols, aromatic acids, aliphatic acids, amines, and thiols have been derivatized with two members of a phospholane series of phosphorus-containing reagents, namely, $ClPOCH_2CH_2O$ and $ClPOCHMe_2CMe_2O$. Measurement of proton-decoupled ^{31}P chemical shifts of these derivatives reveals that, in general, the resonances fall into well-separated regions for derivatized classes of these organic compounds. Both phosphorus reagents were also tested on pyridine extracts of Illinois No. 6 coal, revealing the presence of various phenols, carboxylic acids, and aliphatic alcohols. Similar derivatization of a low-temperature pyrolysis condensate from Illinois No. 6 coal showed no detectable concentrations of carboxylic acids, a relatively small amount of aliphatic alcohols, but considerable quantities of a variety of phenols. The current scope and limitations of this NMR technique and its applicability to the quantitation of -OH, -SH, and -NH functionalities in organic solutions of coal-derived materials are discussed.

37905 Determination of the distribution of ash, pyrite and basic constituents in coal particles. Mason, D.M. (Institute of Gas Technology, Chicago, IL (USA)); Chao, S.S. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(4): 203-213 (1987). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA (USA), 30 Aug - 4 sep 1987).

In fluidized-bed gasification of high-sulfur coals, such as the KRW and U-GAS processes, relatively low melting ash is produced by reaction of iron from pyrite with the siliceous components produced from clays and quartz. To prevent catastrophic growth of ash clinkers and defluidization of the bed, ash in the bed must be limited to 40 to 50 weight percent. As a result of this low ash content of the bed, the ash must be agglomerated to facilitate its removal from the bed without unacceptable loss of char carbon and decrease of gasification efficiency. To obtain a detailed understanding of the behavior of mineral matter and ash in fluidized-bed gasification, a fundamental research investigation is in progress at IGT under a program supported by the US Department of Energy. We envision that the initial formation of ash reaction products occurs by reaction of the minerals present in single particles of char formed from single particles of coal. The oxide composition of the ash of single particles determines their melting point, viscosity and potential for agglomeration. In this paper we report the results of the application of some methods of investigation of ash composition in single particles of coal.

37906 Improved methods for determination of ferrous sulfides in coal chars. Chao, S.S. (Institute of Gas Technology, Chicago, IL (USA)); Mason, D.M.; Attari, A. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(4): 214-220 (1987). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA (USA), 30 Aug - 4 sep 1987).

A hydrochloric acid evolution method using stannous chloride as a promoting agent was developed and employed successfully for

ferrous sulfides determination in 1400°F coal char. This method not only provides an accurate analysis of ferrous sulfides, but also improves the accuracy of the organic sulfur analysis of coal char. We believe this method could be and should be employed in the sulfur-by-types analysis of all coal derivatives containing ferrous sulfides.

37907 Preparation and distribution of Argonne premium coal samples. Vorres, K.S. (Argonne National Lab., IL (USA)). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(4): 221-226 (1987). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA (USA), 30 Aug - 4 sep 1987).

The eight Argonne Premium Coal Samples were each collected in about 1 1/2 ton quantities, placed in steel drums, purged with argon and taken to ANL for processing. After transfer to a nitrogen filled enclosure, they were crushed, pulverized, mixed and packaged in sealed amber borosilicate ampoules containing 10 grams of -20 mesh or 5 grams of -100 mesh sample. Five gallon carboys hold about 80% of the batch in reserve for filling more ampoules after the original about 5,000 of -20 mesh or 10,000 of -100 mesh samples are depleted. More than 70 laboratories are participating in the analysis. Over 90 shipments have been made to more than 45 different organizations for a range of programs which will be the subject of later papers in the symposium.

37908 Small angle neutron scattering studies of swelled coal. Winans, R.E. (Argonne National Lab., IL (USA)); Thiyagarajan, F. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(4): 227-231 (1987). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA (USA), 30 Aug - 4 sep 1987).

The objective of this study is to determine changes that occur in the physical structure of coals upon swelling in an organic solvent. It is known that bituminous coals will swell in solvents such as pyridine. The phenomenon of coal solvent swelling is being used to characterize coal structure especially in the determination of molecular sizes between cross-links. Swelling can affect coal reactivity in thermolysis reactions. Also, it is important to note that swelling increases reagent accessibility in chemical modification of coals. Small angle neutron scattering (SANS) is the approach used in this study to examine the changes in pore structure in a Pittsburgh #8 seam hvA bituminous coal, Argonne Premium Coal Sample #4. Two perdeuterated solvents are used, benzene for non-swollen and pyridine for swelling conditions. The deuterated solvent provides a large contrast between the solvent and the solid coal for neutron scattering. Coal porosity has been studied by SANS in the dry state and in non-swelling deuterated solvents. These studies suggested that this technique can be useful for examining pore structure. Our current results show that the pore structure of a coal swollen in pyridine is dramatically altered from its original state.

37909 Application of inverse gas chromatography to coals and oxidized coals. Neill, P.H. (Argonne National Laboratory, IL (USA)); Winans, R.E. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(4): 266-272 (1987). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA (USA), 30 Aug - 4 sep 1987).

In two previous papers we reported preliminary results concerning the application of Inverse Gas Chromatography (IGC) to coals and air oxidized coals. In this paper we will report on the reproducibility of the IGC technique, its application to other Argonne Premium Coals, and compare the results with those obtained with pyrolysis mass spectroscopy. The objective of this study is to provide detailed information concerning the possible non-oxidative changes in the chemical and physical structures of the Argonne Premium Coal Samples (APCS) during long term storage. Inverse gas chromatography is just one of the techniques being utilized in meeting this objective. It is known that subtle changes in coal structure can effect changes in plasticity when a coal is heated. However, the techniques traditionally used to measure plasticity do not yield information which can be used to understand the underlying chemical and physical changes in the coal structure.

37910 Heat capacities of Argonne premium coal samples. Isaacs, L.L. (City College of the City Univ. of New York, NY (USA)); Tsafantakis, E. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(4): 243-249 (1987). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA (USA), 30 Aug - 4 sep 1987).

The thermal effects on coal have been the subject of numerous investigations dating back to the 1890's. Many techniques have been used to study thermal effects, including differential scanning calorimetry (DSC), differential thermal analysis (DTA) and thermogravimetric analysis. DTA and DSC studies of coals by different researchers yield conflicting information. Numerous heat capacity determination have been done on coals over the years. However in these investigations no particular care was taken to check the effects of weathering on the measured parameters. A number of the coals investigated were the same as those which are part of the Argonne Premium Coal sample series. In this communication we report the results of recent DSC investigations on the Argonne Premium Coal Sample series. In these experiments care was taken to correlate the heat capacity with the thermal history of the specimens.

37911 Isotope dilution study of exchangeable oxygen in premium coal samples. Finseth, D. (Pittsburgh Energy Technology Center, PA (USA)). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(4): 260-265 (1987). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA (USA), 30 Aug - 4 sep 1987).

A difficulty with improving the ability to quantitate water in coal is that truly independent methods do not always exist. The true value of any analytical parameter is always easier to determine if totally independent methods exist to determine that parameter. This paper describes the possibility of using a simple isotope dilution technique to determine the water content of coal and presents a comparison of these isotope dilution measurements with classical results for the set of Argonne coals from the premium coal sample program. Isotope dilution is a widely used analytical method and has been applied to the analysis of water in matrices as diverse as chicken fat, living humans, and coal. Virtually all of these applications involved the use of deuterium as the diluted isotope. This poses some problems if the sample contains a significant amount of exchangeable organic hydrogen and one is interested in discriminating exchangeable organic hydrogen from water. This is a potential problem in the coal system. To avoid this potential problem ^{18}O was used as the diluted isotope in this work.

37912 Multinuclear NMR characterization of the layer silicates in Argonne premium coals and model systems. Thompson, A.R. (Argonne National Lab., IL (USA)); Botto, R.E. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(4): 280-285 (1987). DOE Contract W-31-109-ENG-38. (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA (USA), 30 Aug - 4 sep 1987).

A variety of pulse sequences have been used to obtain solid-state aluminum-27 and silicon-29 nuclear magnetic resonance (NMR) spectra on the mineral matter in Argonne Premium Coals. The aim of this research investigation is two-fold; to improve our knowledge of minerals found in coals and to elucidate the possible roles of layer silicates in coal formation. To facilitate the latter objective, layer silicates that are intimate with the carbonaceous portion and present during coalification must be identified. Nuclear magnetic resonance should provide valuable information because it is sensitive to all mineral particles independent of their size and it is a direct characterization method, thus does not require any modification of the coals. In the present study, NMR has been applied to the entire suite of Argonne Premium Coals before and after separation of the detrital mineral particles by sink-float separation. Preliminary results are presented for the direct characterization of the minerals more intimately associated with the organic portion of these coals.

37913 EPR study of nitroxide spin probe doped Illinois No. 6 coal from the Premium Coal Sample program: reactive site distribution. Kispert, L.D. (Univ. of Alabama, Tuscaloosa (USA)); Cooray, L.S.; Wuu, S.K. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(4): 286-292 (1987). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA (USA), 30 Aug - 4 sep 1987).

Recently, we reported a method to determine the relative pore (accessibility) size and number distribution in selected high-volatile

bituminous coal samples by diffusing nitroxide spin probes of different shapes, varying in diameter or length from 0.47 nm to 3.5 nm, into the swellable pores of the coal samples. The relative spin probe concentration was measured by Electron Paramagnetic Resonance (EPR) methods for each sized spin probe. From these measurements, a relative number and size distribution was estimated for the swellable pores of Mary Lee (MRI, PSOC-271) and Black Creek (MRI) coal seams of Alabama and the Illinois no. 5 (PSOC-699) seam. This study reports the results of a series of similar but small sized spin probes (~ 0.6 nm in diameter), each containing a different reactive substituent, to determine the number distribution of reactive sites containing acid, phenol and amine substituents. The smaller size of the spin probes with reactive sites, will permit a measure of all accessible sites with diameters greater then approximately 0.6 nm. In addition, a study was made to differentiate hydrogen-bonding to the nitroxyl group from that of a substituent group in swellable pores with diameters of approximately 0.4-0.6 nm.

37914 Investigation on the nature of steam modified coal. Brandes, S.D. (City College of New York, NY (USA)); Graff, R.A. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 385-393 (1988). (CONF-870802--: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

In previous work it was found that dramatically improved liquid yields from steam pyrolysis and mild solvent extraction of bituminous coal are obtained when the coal is first exposed to subcritical steam for short periods of time (Graff and Brandes, 1984 and 1987). This finding motivated the investigation, reported here, into the nature of coal after modification by subcritical steam. In this work solvent swelling, a technique to determine the degree of cross-linking between macromolecular units in coal (Green, et al. 1984), has been applied. An estimate of the degree of hydrogen bonding in the coal was thereby obtained. Treated coal was also analyzed by diffuse reflectance infrared spectroscopy (DRIS) and by an o-alkylation procedure described by Liotta (1981). The results of these three studies are described in this paper.

37915 Structural information from the selective methylation of acidic O-H and C-H sites in an Argonne Premium Coal Sample. Chambers, R.R. Jr. (Oak Ridge National Lab., TN (USA)); Hagaman, E.W.; Woody, M.C. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(4): 309-313 (1987). DOE Contract AC05-84OR21400. (CONF-870802--: 194. American Chemical Society national meeting, New Orleans, LA (USA), 30 Aug - 4 sep 1987).

With the establishment of the Argonne Premium Coal Sample Program, a long-term supply of a limited number of coal samples for basic research has become available to the coal research community. These coals offer the advantage of having been processed and stored under the controlled conditions of relative humidity, temperature, minimum oxygen exposure, etc. Since special care has been taken to insure sample homogeneity, direct inter-laboratory comparisons of experimental results will now be possible. Furthermore, it will now be possible to evaluate the chemical and physical changes which accompany the long-term storage of coal.

37916 Spectroscopic characterization of Argonne Premium Coals and short residence time liquefaction products. Franz, J.A. (Pacific Northwest Lab., Richland, WA (USA)); Alnajjar, M.S.; Linehan, J.C. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(4): 324-330 (1987). (CONF-870802--: 194. American Chemical Society national meeting, New Orleans, LA (USA), 30 Aug - 4 sep 1987).

Illinois No. 6 (high volatile bituminous), Pittsburgh No. 8 (bituminous), Wyoming Subbituminous, Pennsylvania Upper Freeport (medium volatile bituminous) and Pocahontas #3 (low volatile bituminous) coals from the Argonne Premium Coal Sample Program were heated in tetralin for 10 minutes at 430 ±5°C. The products were examined by gel permeation chromatography and ^{13}C NMR spectroscopy. Yields for conversion of the coals to THF-soluble products were determined. Yields and GPC characteristics of products from direct extraction of the coals with THF were determined. The most reactive coal in this group, based on conversion to products below MW 600, appears to be Wyoming subbituminous.

37917 Characterization of the benzene methanol extracts from the Argonne Premium Coal Samples. Xia, Y.J. (Argonne National Lab., IL (USA)); Neill, P.H.; Winans, R.E. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(4): 340-346 (1987). DOE Contract W-31-109-ENG-38. (CONF-870802--: 194. American Chemical Society national meeting, New Orleans, LA (USA), 30 Aug - 4 sep 1987).

The Argonne Premium Coal Samples represent a unique opportunity to study a set of pristine samples selected to represent the vast diversity of chemical structures exhibited by US coals. In order to determine if there will be any non-oxidative changes in these coals during long term storage a project has been initiated utilizing a wide range of chemical and physical techniques. One of these techniques meant to focus on any changes which may occur in the volatiles and extractables is described in this paper. We believe that the material that can be extracted from the coal will provide important information concerning any changes which may occur during long term storage. These materials are easily studied by well established techniques and the suggestion has been made that they may be representative of the chemical structures found in the bulk coal. The data reported in this paper represents baseline values for the benzene/methanol extractables from the Argonne Premium Coals. The next phase of the project will involve the repetition of these experiments in order to determine if any changes are occurring during storage.

37918 Comparative study on the compositional characteristics of pyrolysis liquids derived from coal, oil shale, tar sand, and heavy residue. Khan, M.R. (Morgantown Energy Technology Center, WV (USA)); Seshadri, K.S.; Kowalski, T.E. *Energy and Fuels (USA),* 3(3): 412-420 (May-Jun 1989).

A range of fossil fuels (e.g., coal, oil shale, tar sand, and a heavy residue) were pyrolyzed at a relatively low temperature and their liquid products were characterized. Fractionated liquid samples were analyzed to obtain more meaningful and detailed results. Sequential elution solvent chromatography (SESC) was used for this purpose in this work. Subsequent separation of the first fraction of SESC into saturates/alkenes and aromatics was achieved by using a semipreparative high-performance liquid chromatograph (HPLC). SESC and HPLC fractions were analyzed by using field ionization mass spectroscopy (FIMS). Separation and spectroscopic characterization results including infrared analysis of solid fuels and pyrolysis liquids, chromatographic profiles of aromatics in several pyrolysis liquids, and a comparison of abundance of acyclic and cyclic alkanes for tar sand liquid, Colorado shale oil, and Pittsburgh No. 8 coal liquid are presented. Using FIMS data in the Z-series type formates, alkanes and cycloalkanes were identified in the three samples. The tar sand pyrolysis liquid and the Colorado shale oil apparently contain almost identical structures. The coal pyrolysis liquid, however, shows a different product distribution. On the basis of the naphthenic carbon content as percent of total liquids, the fuels can be ranked in the following order as feedstocks for advanced fuels: Asphalt Ridge tar sand > western shale > Pittsburgh No. 8 coal > eastern shale. The aromaticities of the liquids decrease in the following order: Pittsburgh coal liquid > eastern shale oil > western shale oil > tar sand liquid. However, the ranking of fuels based on liquid analyses can be expected to change depending on the process conditions chosen for upgrading and heteroatom removal. 18 refs., 10 figs., 7 tabs.

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Refer also to citation(s) 37934, 38274, 38651

37919 (CONF-890692--18) **Combined NO_x/SO_2 control with dry sorbents.** Livengood, C.D.; Harkness, J.B.L. Argonne National Lab., IL (USA). 1989. 16p. Sponsored by DOE Fossil Energy. DOE Contract W-31109-ENG-38. From 82. Air and Waste Management Association annual meeting and exhibition; Anaheim, CA (USA); 25-30 Jun 1989. Order Number DE89015137/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Argonne National Laboratory (ANL) has been conducting research on combined NO_x/SO_2 control systems. Recently, the research program has been focused on spray-dryer-based FGC systems and has involved research on NO_x removal enhancement

through chemical additives and modified process conditions. Tests have been conducted in a laboratory-scale spray dryer at ANL, an intermediate-scale system at the Pittsburgh Energy Technology Center, and Argonne's commercial-scale spray-dryer/fabric-filter system. In addition, the performance of dry sorbent/additive combinations under a variety of conditions has been studied at ANL using a laboratory-scale fixed-bed reactor. The experimental conditions were selected to model the post air-preheater environment for a boiler firing high-sulfur coal, and to specifically address conditions expected in the fabric filter portion of a spray dryer or duct injection system. We describe the fixed-bed experimental facility and the results of both statistically designed and parametric experiment series conducted using a lime ($Ca(OH)_2$)sorbent and a variety of additives. 6 refs., 7 figs., 2 tabs.

37920 (CONF-8902106–1) **Combined NO_x/SO_2 control technology.** Livengood, C.D. Argonne National Lab., IL (USA). 1989. 24p. Sponsored by DOE Fossil Energy. DOE Contract W-31109-ENG-38. From NO_x control conference; Industry, CA, USA; 7-8 Feb 1989. Order Number DE89012388/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Commercially available technology for the removal of both NO_x and SO_2 from flue gases generally involves separate systems for each pollutant. Current research and development efforts emphasize integrated technologies that combine NO_x/SO_2 (and perhaps particulate matter) control in one system to reduce costs and improve operability. This paper reviews a number of integrated processes that have reached a significant stage of development in terms of their operational principles, process configurations, byproducts, costs (where available), and developmental status. 28 refs., 13 figs.

37921 SO_x-NO_x control in a staged cyclone coal combustor with limestone injection. Zauderer, B. (Coal Tech Corporation, Merion Station, PA (USA)); Fleming, E.; Swift, W.M. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(4): 375-382 (1987). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA (USA), 30 Aug - 4 sep 1987).

The results of a preliminary experimental study of SO_x-NO_x control in a two-stage cyclone coal combustor (2 MW) with limestone injection are presented. The tests were carried out using a finely pulverized West Virginia low-sulfur bituminous coal (0.8% S), an Illinois No. 6 medium-sulfur coal (1.6% S), and an Illinois No. 6 high-sulfur coal (2.7% S). With limestone injection in either the first or second stage of the combustor, SO_2 reductions in excess of 80% were obtained. The sorbent injection tests indicated that the first-stage combustion temperature as influenced by the air/fuel ratio was a major factor in sulfur capture. NO_x emissions measured by the air/fuel ratio was a major factor in sulfur capture. NO_x emissions measured at the exit of the second-stage combustor were reduced by up to 55% over those from single-stage combustion. In addition, the benefits of a staged cyclone combustor for NO_x control were enhanced when the second-stage gas temperature was minimized, either through increasing second-stage air dilution or by maximizing first-stage carbon conversion.

37922 Combined NO_x/SO_2 removal from flue gas using ferrous chelates of SH-containing amino acids and alkali. Liu, D.K. (Univ. of California, Berkeley (USA)); Chang, S.G. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(4): 444-451 (1987). DOE Contract AC03-76SF00098. (CONF-8708275–: American Chemical Society Division of Fuel Chemistry meeting, New Orleans, LA (USA), 30 Aug - 7 sep 1987).

We report herein the use of ferrous chelates of SH-containing amino acids including cysteine, penicillamine, N-acetylcysteine, and N-acetylpenicillamine in neutral or alkaline solutions for the combined removal of NO and SO_2 in wet flue gas clean-up systems. These SH-containing amino acids not only can stabilize ferrous ions in alkaline solutions to promote the absorption of NO, but are also capable of rapidly reducing ferric ions formed during the scrubbing process back to ferrous ions. The disulfide from of the above amino acids can be reduced by SO_2 and H_2S to regenerate the starting monomeric species. The chemistry relevant to the absorption of NO by the above ferrous chelates and the ligand regeneration process will be discussed.

37923 Activation of flue gas nitrogen oxides by transition metal complexes. Miller, M.E. (Department of Energy, Pittsburgh, PA (USA)); Finseth, D.H.; Pennline, H.W. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(4): 465-470 (1987). (CONF-8708275–: American Chemical Society Division of Fuel Chemistry meeting, New Orleans, LA (USA), 30 Aug - 7 sep 1987).

Sulfur and nitrogen oxides are major flue gas pollutants released by coal-fired electric power plants. In the atmosphere these oxides are converted to sulfuric and nitric acids, which contribute to the acid rain problem. Most of the nitrogen oxides (90%-95%) present in coal-derived flue gas exist as the relatively inert and water-insoluble nitric oxide (NO), thus presenting a difficult removal problem. A practical strategy for nitrogen oxides removal might utilize a solid support that has been impregnated with an active transition metal complex. Some supported transition metals are expected to remove NO_x by sorption, with regeneration of the sorbent being a necessary property. Others catalyze NO oxidation to the more soluble NO_2 and N_2O_5, which has been demonstrated for certain transition metal species. These activated nitrogen oxides can be more efficiently removed along with SO_2 in conventional scrubbing or spray-drying processes, in which an aqueous slurry of sorbent, such as hydrated lime, is injected into the hot flue gas. We present here preliminary studies intended to establish basic homogeneous chemistry of transition metal complexes with nitrogen oxides. The transition metals considered in this work are volatile carbonyl complexes. This work is the first step in the development of supported metal species for enhanced nitrogen oxides removal.

37924 New strategy to decompose nitrogen oxides from regenerable flue gas cleanup processes. Yeh, J.T. (Department of Energy, Pittsburgh, PA (USA)); Ekmann, J.M.; Pennline, H.W.; Drummond, C.J. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(4): 471-483 (1987). (CONF-8708275–: American Chemical Society Division of Fuel Chemistry meeting, New Orleans, LA (USA), 30 Aug - 7 sep 1987).

Simulated NO_x recycle tests were recently conducted at the Pittsburgh Energy Technology Center (PETC), US Department of Energy, with excellent results. However, the NO_x-recycle technique needs improvement if steady-state removal of 90% of the NO_x produced from the combustor is required. This paper reports experimental results for two new techniques to improve the destruction of externally injected NO_x into a combustor. The first technique involves doping the NO_x gas stream to the combustor with methane (other reductants might also be effective). The second technique is injecting the recycled NO_x stream at the optimum location (with and without methane doping) for maximum reduction. Test data showed 100% reduction of injected NO_x is possible with this technique. A third approach is proposed using a low-NO_x burner in combination with the NO_x recycle technique to achieve a steady-state 90% NO_x removal in the flue gas. The projected results of the third process scheme are based on material balance computations and reasonable expectations of the performance of each component of the process.

0109 Environmental Aspects

37925 (SNV–3563) **Emissions of acidification pollutants 1987.** Statens Natuurvaardsverk, Solna (Sweden). 1989. 28p. (In Swedish). Available from Statens Naturvaardsverk, Solna (Sweden).

The Swedish government is committed to reducing emissions of sulfur dioxide and nitrogen oxides by 65% and 30% respectively, by 1995 compared with 1980, and sulphur dioxide emissions by 80% by the year 2000. This report shows that SO_2 and NO_x levels had been reduced by 56% and 5%, respectively, by the end of 1987. Between 1986 and 1987, sulphur emissions were reduced by 25000 tons, due to decreased oil usage and industrial process emissions and the retrofitting of several coal-fired plants with desulphurisation units. Total emission of nitrogen decreased by approximately 4000 tons due to reduced oil consumption and increased use of electrical energy and natural gas. Emissions of SO_2 from industrial processing fell by 3000 ton between 1986 and 1987. Most of the reduction occurred in the cellulose, chemical and ferro alloy industries. Emissions of NO_x remained unchanged compared with 1986. Road

traffic emissions of NO_x have increased by 23000 ton since the beginning of the 1980s and the sale of cars with catalysts has been unable to reverse the trend. The report briefly considers existing flue gas cleaning techniques and the development of measures for controlling acidic emissions from road traffic, industrial processes and energy producing plants.

0110 Reserves and Exploration

Refer also to citation(s) 37898

0120 Mining

Refer also to citation(s) 37936, 37937, 38524

37926 (IOM-TM–89-01) **Further environmental aspects of the use of diesel-powered equipment in coal mines.** Robertson, A.; Garland, R.P.; Cherrie, B.; Nee, J.R.D. Institute of Occupational Medicine, Edinburgh (UK). Jan 1989. 36p. Available from Institute of Occupational Medicine, Edinburgh (United Kingdom).

Diesel powered equipment has been used in coal mines for over forty years and there is much concern about the potential adverse effects on general respiratory health of exhaust emissions from this equipment and their possible carcinogenicity. In UK coal mines this concern has recently centred around the use of diesel free steered vehicles (FSV's). Previous work showed that, in one drivage, diesel FSV's gave rise to higher levels of oxides of nitrogen and carbon monoxide than those found in similar drivages where diesel locomotives were used. The present study was designed to investigate this further. The study was based on six, one week surveys of nitric oxide, nitrogen dioxide, carbon monoxide, formaldehyde, respirable dust and polyaromatic hydrocarbons. These were carried out in three collieries where diesel FSV's are used to transport men and materials. Sampling was carried out in drivages, face return roadways, transfer points, garages and at the pitbottom. In all three collieries levels of noxious emissions were low. The highest measured concentrations of nitrogen dioxide, carbon monoxide and formaldehyde were 0.3 ppm, 15 ppm and 0.5 ppm respectively. (The current UK occupational exposure limits for these gases are 3 ppm, 50 ppm and 2 ppm respectively). A range of polyaromatic hydrocarbons was analysed. These included pyrene, benzo(a)anthracene, chrysene, benzo(a)pyrene and benzofluoranthene. Only traces of these materials were detected, all at concentrations below 80 ng/m^3. These results were primarily due to good ventilation, the care taken in routine vehicle maintenance and good working practices. None of the situations studied involved use of vehicles for moving coal and stone underground. Higher concentrations of emissions would be expected in those circumstances, but such 'load, haul and dump' operations with diesel-powered vehicles do not normally occur in modern longwall mining practice in the UK.

0130 Transport and Handling

Refer also to citation(s) 37909, 37935, 38647, 38652

37927 (DOE/PC/70805–T2) **Fundamental studies of bulk flow of fine coal: Final technical report.** Hogg, R.; Luckie, P.T.; Kumar, A. Pennsylvania State Univ., University Park, PA (USA). 24 Apr 1989. 188p. Sponsored by DOE Fossil Energy. DOE Contract FG22-84PC70805. Order Number DE89010823/JAW. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

The shear stress characteristics of fine coal and the flow properties as applicable to overhead storage (silos, bunkers, etc.) have been determined in this investigation. An evaluation of these flow properties has been determined from two types of shear stress measurement devices, the Jenike Shear Cell Tester and the Peschl Shear Cell Tester. The two shear testers differs basically in respect of the direction of relative movement of the two parts (fixed and moving) of the shear cell. A method has been suggested to determine the major principal stress and the effective angle of internal friction independent of the determination of the yield locus. The graphical plots show that the new method substantially reduces the uncertainty in the value of the two flow properties, the effective angle of internal friction and the flow function. Additionally, the effect of particle size and surface moisture content in the coals on the flow function has been studied and a stepwise regression model building technique known as residual analysis has been applied to correlate the flow function parameters to the particle size and the moisture content. 49 refs., 48 figs., 7 tabs.

0140 Combustion

Refer also to citation(s) 37921, 38650

37928 (CONF-890819–16) **Spectral dynamics of computer simulated two-dimensional fewtube fluidized beds.** Chang, S.L.; Lyczkowski, R.W.; Berry, G.F. Argonne National Lab., IL (USA). Jan 1989. 15p. Sponsored by DOE Fossil Energy. DOE Contract W-31109-ENG-38. From ASME/AIChE national heat transfer conference; Philadelphia, PA, USA; 6-9 Aug 1989. Order Number DE89013643/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Fluidized bed combustion technology attracts intense commercial interest for its capability of burning high-sulfur coal in a more economic and environmentally acceptable manner, despite the unsolved erosion problem. Detailed knowledge of the complex phenomena of solids circulation and bubble motion in the bed could enhance the understanding of the problem and find solutions. Argonne National Laboratories (ANL) has been developing a methodology to investigate local erosion phenomenon in bubbling fluidized bed combustor (FBC) systems: (1) use of state-of-the-art two-phase two-dimensional hydrodynamic computer model (FLUFIX) to compute temporal and spatial distributions of the flow properties in an FBC and (2) use spectral analysis and several separated erosion models to evaluate flow dynamics and local erosion patterns and rates. In this paper, the spectral analysis uses the computational hydrodynamic results of a two-dimensional generic fewtube FBC system to correlate flow properties, porosity, pressure and velocities, as well as to determine oscillation modes and bubble propagation speeds. Several findings from this analysis are: flow properties have major oscillation modes of frequencies ranging from 0.7 to 4 Hz; porosity and pressure oscillations propagate from the bottom of the bed up with propagation speeds ranging from 0.4 to 1 m/s; pressure is well correlated with the lagging porosity at a location; phase diagrams show the randomness of oscillations but the attractor leading to chaotic motion is not found. 14 refs., 11 figs.

37929 (DOE/MC/22137–2704-Vol.2) **Computational fluid dynamics assessment: Volume 2, Isothermal simulations of the METC bench-scale coal-water slurry combustor: Final report.** Celik, I.; Chattree, M. West Virginia Univ., Morgantown, WV (USA). Dept. of Mechanical and Aerospace Engineering. Sep 1988. 271p. Sponsored by DOE Fossil Energy. DOE Contract AC21-85MC22137. Order Number DE89000991/JAW. Available from NTIS, PC A12/MF A01 - OSTI; GPO Dep.

The isothermal turbulent, swirling flow inside the METC pressurized bench-scale combustor has been simulated using ISOPCGC-2. The effects of the swirl numbers, the momentum ratio of the primary to secondary streams, the annular wall thickness, and the quarl angle on the flow and mixing patterns have been investigated. The results that with the present configuration of the combustor, an annular recirculation zone is present up to secondary swirl number of four. A central (on axis) recirculation zone can be obtained by increasing the momentum of the secondary stream by decreasing the annular area at the reactor inlet. The mixing of the primary (fuel carrier) air with the secondary air improves only slightly due to swirl unless a central recirculation zone is present. Good mixing is achieved in the quarl region when a central recirculation zone is present. A preliminary investigation of the influence of placing flow regulators inside the the combustor shows that they influence the flow field significantly and that there is a potential of obtaining optimum flow conditions using these flow regulators. 58 refs., 47 figs., 12 tabs.

37930 (DOE/PC/88929–T1) **Scale-up of circulating fluidized bed coal combustors: Progress report third quarter, March 1, 1989–May 31, 1989.** Louge, M.Y. Cornell Univ., Ithaca, NY (USA). Sibley School of Mechanical and Aerospace Engineering. 1989.

13p. Sponsored by DOE Fossil Energy. DOE Contract FG22-88PC88929. Order Number DE89015767/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This project is aimed at quantifying the effects of scale-up upon the hydrodynamics of circulating fluidized bed coal combustors (CFB). To this end, we have constructed at Cornell a cold CFB facility that can operate with controlled fluidization gas mixtures. In addition, we have developed new capacitance diagnostics to investigate local flow parameters in the bed. In order to test the new facility and its diagnostics, we have reproduced fluidization experiments that can be compared with available literature data. In these experiments, we have found pressure profiles in agreement with similar data, indicating reliable operations of the facility. Further, our diagnostics have revealed new details of the flow near the wall of the CFB riser. The present report will summarize these results obtained during the third quarter of the project. 8 refs., 11 figs., 1 tab.

37931 Coal-water mixture combustion using oxygen-enriched air and staged firing. Fu, Y.C. (Department of Energy, Pittsburgh, PA (USA)); Bellas, G.T.; Joubert, J.I. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(4): 82-93 (1987). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA (USA), 30 Aug - 4 sep 1987).

Coal-water mixture (CWM) combustion experiments using oxygen-enriched air were conducted in an oil-designed 700-hp watertube boiler using a bituminous CWM. The results indicated that the use of oxygen-enriched air increased carbon burnout, reduced uncontrolled fly ash emissions, and reduced combustion air preheating requirements. The boiler efficiency increased because of reduced flue gas heat losses. The improvement in boiler performance compared to an experiment without oxygen enrichment was significant when using only 2-3 percent enrichment of air (23-24 volume percent oxygen). Using combustion air enriched to 22.7 percent oxygen by volume, the required air preheating temperature was reduced to 192°F as compared to 325°F required with no oxygen enrichment, while the carbon conversion efficiency at full boiler load was increased from 95.0 percent to 97.4 percent. Experiments on CWM combustion were also conducted using staged firing with and without oxygen-enriched air. The NO_x reduction achieved at a first-stage air/fuel stoichiometric ratio of 0.76 was about 33 percent, but it was accompanied by a reduction in combustion efficiency and an increase in particulate emissions. The use of oxygen-enriched air in the burner zone increased flame stability and carbon burnout while maintaining the effectiveness of staged combustion; however, additional experiments are needed to optimize burner-operating parameters to achieve significant NO_x reduction.

37932 Effect of sodium on deposition in a simulated combustion gas turbine environment. Ross, J.S. (Department of Energy, Morgantown, WV (USA)); Anderson, R.J.; Nagarajan, R. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(4): 114-131 (1987). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA (USA), 30 Aug - 4 sep 1987).

The effect of gas phase alkali concentration on the adhesion properties of micronized coal has been studied using a laboratory-scale entrained reactor capable of accelerating the combustion products of an injected coal-air mixture to the velocities observed in a combustion gas turbine. Alkali metal sulfates are reputed to act as liquid glue binders which promote inorganic deposit formation under these conditions. In this study, the concentration of alkali was varied by utilizing a series of naturally occurring coals (Arkwright Pittsburgh bituminous, Spring Creek Montana subbituminous, and North Dakota lignite), and by doping Arkwright coal samples with sodium benzoate. Measured sticking coefficients (i.e., the mass fraction of incident ash which sticks to a deposition target) obtained from this series exhibited trends consistent with the glue hypothesis and with the amount of liquid phase sodium sulfate predicted by equilibrium thermodynamic and vapor deposition rate calculations. Thus, between the melting point and dew point of sodium sulfate, higher sodium concentrations in the coal feed resulted in enhanced sticking. Below the sulfate melting point, the sodium concentration had no effect. These measurements provide a confirmation of the glue-like behavior of sodium sulfate in enhancing deposition rates and represent the first successful probing of the effect of an individual element upon the properties of fly ash originating from natural and chemically doped fuels under gas turbine combustor temperature and velocity conditions.

37933 Determination of atomic sodium in coal combustion using laser-induced fluorescence. Sweeny, P.G. (Univ. of North Dakota, Grand Forks (USA)); Abrahamson, H.B.; Radonovich, L.J.; Ballintine, T.A. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(4): 186-192a (1987). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA (USA), 30 Aug - 4 sep 1987).

A laser-induced fluorescence spectrometer (LIFS) was assembled and sodium atom densities produced from the aspiration of solutions and direct introduction of a lignite into a flame were determined from fluorescence measurements. The average flame volume observed was $0.4mm^3$. This small volume allowed the measurement of sodium concentrations as a function of vertical and horizontal flame position. Temperature profiles of the flames employed were also obtained and compared with the sodium atom densities. The sodium atom densities calculated from the fluorescence measurements (N_{fl}) are compared with the sodium atom densities calculated from thermodynamic considerations (N_{tl}) and sodium concentrations derived from aspiration/introduction rates (N_{ta}).

37934 Sulfur impact on coal-fired gas turbines. Wen, C.S. (Solar Turbines Incorporated, San Diego, CA (USA)); Cowell, L.H. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(4): 383-394 (1987). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA (USA), 30 Aug - 4 sep 1987).

Sulfur is one of the key elements in coal fuel specifications which requires particular attention. Emissions of sulfur oxides as well as the condensation and/or deposition of corrosive sulfates on blades are major problems in the development of coal-fired gas turbines. Substantial sulfur removal will be needed in order to meet environmental standards and to reduce the interaction between sulfur and alkali compounds. Several processes exist so that clean-up of sulfur is feasible, but they are expensive. Economic considerations will continue to force greater usage of minimally cleaned coal (i.e., coal with high ash and/or sulfur content). An understanding of the role of sulfur during coal combustion and its impact on gas turbines will benefit control of sulfur emissions and corrosion. This paper reviews the role of sulfur in two-stage slagging coal combustion and discusses its impact on coal-fired gas turbines.

0150 Marketing and Economics

Refer also to citation(s) 37834, 38512, 38639

37935 (IEACR–15) **World coal ports.** Mannini, A. IEA Coal Research, London (UK). c Apr 1989. 114p. Available from IEA Coal Research, 14-15 Lower Grosvenor Place, London SW1W OEX, England.

This report details berthing and operation facilities for over 400 existing and projected coal handling ports. Major coal exporting countries are listed individually while coal importing countries are listed in geophysical groups. An account is given for most countries, with a brief history of coal trade and important issues with regards to coal port infrastructure. Maps are included for locating ports with a capacity for vessels of 30,000 dwt and over (for Japan, only ports with 100,000 dwt and over are mapped). An overview of seaborne coal trade identifies the main features of coal port capacity in exporting and importing counties. Tables and figures give a breakdown of country capacity and coal trade. The report is indexed by port. 16 refs., 4 figs., 7 tabs.

0160 Health and Safety

Refer also to citation(s) 37926

37936 (IOM-TM–88-06) **Cross sectional studies of respiratory disease in British coalminers.** Soutar, C.A.; Campbell, S.J.; Gurr, D.C.; Lloyd, M.H.; Love, R.G.; Cowie, H.A.; Cowie, A.J.; Seaton, A. Institute of Occupational Medicine, Edinburgh (UK). Jan

1989. 99p. Available from Institute of Occupational Medicine, Edinburgh (United Kingdom).

The influence of exposure to respirable coal mine dust on syndromes of respiratory disease other than pneumoconiosis has been examined in cross-sectional studies of coal miners in three collieries in Britain (S. Wales, Yorkshire and Tyne and Wear). Nearby telecommunications workers and postmen were included also to permit comparisons with non-coal mining populations. The sample was selected from those who had worked in their industries between 1970 (when new coal mine dust control regulations were introduced in the coal mining industry) and the date of survey (between 1981 and 1986). Frequencies of respiratory symptoms were greater in current miners than current telecommunications workers or postmen in each area, and a similar pattern was observed in those who had left. The presence of large opacities of progressive massive fibrosis was associated with defects characterised by small lungs, airflow obstruction and impaired gas transfer, and this would be consistent both with direct destruction of lung by the fibrosis, and also the presence of associated emphysema. An adverse influence on lung function of lifetime exposure to respirable dust was demonstrated in the S. Wales miners but could not be confirmed in the miners in the other two collieries. This was partly because of confounding of the effects of age and exposure. The estimated risks of having an FEV_1 (a lung function variable) deficit of -422 ml in the S. Wales colliery in non-smokers aged 55, was 28% at zero dust exposure rising to 57% at 400 ghm^{-3} exposure (a high exposure for this population). In smokers the corresponding risks were 36% and 66% respectively. The estimated risks of having an FEV_1 deficit of -942 ml at these dust exposures were respectively 4% and 21% for non-smokers and 12% and 46% smokers.

37937 (IOM-TM–88-18) **Hearing abilities of a group of mine workers in relation to their age and estimated noise exposures.** Institute of Occupational Medicine, Edinburgh (UK). Jun 1989. 86p. Available from Institute of Occupational Medicine, Edinburgh (United Kingdom).

Using existing noise level measurements, detailed working records of individual miners and data on hearing abilities supplied by British Coal Medical Services, the hearing abilities of colliery Q coalmine workers have been investigated in relation to their age and noise exposure. Noise levels in colliery Q were typical of those found in the British Coal Industry. The individual mean lifetime exposures (average Leq) to noise were found to lie between 86 and 93 dB(A) with 83% of men exposed on average between 88 and 91 dB(A). The hearing levels of the colliery Q miners were, however, found to be similar to predicted from typical age-matched, non-noise exposed populations. These differences are not readily explicable from the data available and require further investigation. There was no significant correlation, after allowing for age, of hearing level with noise exposure amongst a subset of 197 men whose estimated lifetime noise exposure was well defined. In view of the forthcoming noise control regulations and the fact that we do not know whether colliery hearing levels of Q men are fully representative of the UK coal industry the report recommends that a further cross-sectional study is undertaken to investigate hearing levels amongst miners from a number of collieries in relation to age.

02 PETROLEUM

Refer also to citation(s) 38032

37938 (CHOA–8709) **Surface facilities optimization program. Proceedings [of the] fifth quarterly meeting of the Canadian Heavy Oil Association.** Canadian Heavy Oil Association (Canada). 1987. vp. (CONF-8709445–: 6. quarterly meeting of the Canadian Heavy Oil Association, Calgary, Canada, 22 Sep 1987;CE–02642). Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $N/C.

A meeting was held in Alberta to consider optimization of heavy oil surface facilities. Papers were presented on the topics of materials used in heavy oil operations, slop oil treatment, demulsification, well test systems, and heavy oil project planning. Separate abstracts have been prepared for five papers from this meeting.

0201 Reserves

Refer also to citation(s) 37942, 37944, 37945, 38048

37939 (DOE/FE–0136) **Sulphur Mines underground storage facility description.** Department of Energy, Washington, DC (USA). Office of Strategic Petroleum Reserve. Jul 1989. 27p. Sponsored by DOE Fossil Energy. Order Number DE89013877/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Strategic Petroleum Reserve (SPR) has 26 million barrels of crude oil stored in salt caverns at its Sulphur Mines storage facility. As part of the process of continued development of the SPR, the government has determined that it would be more cost effective to decommission the relatively small Sulphur Mines crude oil storage facility and replace that storage capacity (26 million barrels) at one or more of the larger SPR sites. The Sulphur Mines oil either would be transferred to these larger sites or arrangements made to provide equivalent volumes to the larger sites, and the Department of Energy would then relinquish the Sulphur Mines facility. Planning is in progress for the decommissioning of the Sulphur Mines storage site, including, if necessary, the transfer of the crude oil. Recognizing that the SPR's completely developed and operating Sulphur Mines crude oil storage facility could be attractive to commercial interests considering or seeking underground crude oil or petroleum product storage capacity, brining facilities or other commercially viable uses, the Department is seeking to ascertain the degree, if any, of commercial interest in this facility. The Sulphur Mines facility is described in this report. 12 figs., 3 tabs.

37940 (GAO/RCED–88-174) **Naval Petroleum Reserve-1.** General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. 1988. 15p. Available from General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

In March 1987, GAO reported on data inaccuracies at the Naval Petroleum Reserve No. 1 in California, stating that these inaccuracies probably result in incorrect computations of the maximum efficient production rates and could result in the government getting less than its share of remaining recoverable reserves should NPR-1 be sold. The Department of Energy's actions in response to the report's recommendations improved the accuracy of production data; other actions still underway, when completed, could largely correct the inaccuracies. DOE also established improved internal controls over review and evaluation.

37941 (SAND–88-2710C) **Modified local similarity for natural convection along a nonisothermal vertical flat plate including stratification.** Webb, S.W. Sandia National Labs., Albuquerque, NM (USA). 1989. 11p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890819–9: ASME/AIChE national heat transfer conference, Philadelphia, PA, USA, 6-9 Aug 1989). Order Number DE89010331/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

An approximate method has been developed to analyze natural convection along a vertical flat plate with variable surface conditions and temperature stratification. This method uses the boundary layer velocity and temperature profiles from the local similarity method and imposes explicit conversion of energy along the plate resulting in required relationships for the similarity parameters for energy conservation. The results from this Modified Local Similarity (MLS) method are compared to those from other methods for a number of nonsimilar natural convection problems. Based on these comparisons, the MLS method is a significant improvement to the local similarity approach and is a useful approximate tool for analyzing natural convection on vertical surfaces for nonsimilar conditions. 22 refs., 11 figs.

0202 Geology and Exploration

Refer also to citation(s) 37980, 38020, 38038, 39102

37942 (AOSTRA–8808, pp. 10) **Heavy oil discovery in Islamic Republic of Iran.** Moshtaghian, A. (National Iranian Oil Co., Iran); Molekzadeh, R.; Azarpanah, A. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy

crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

The systematic exploration of heavy oil deposits in the southwestern part of Iran began in 1984, when the first exploration well was completed at a depth of 1450 m on the Kuh-e Mond anticline. The result confirmed the occurrence of heavy oil in two separate carbonate reservoirs, the Jahrum (Eocene) and Sarvak (Cretaceous) Formations. The thickness of Jahrum is about 450 m and it contains oil of 8^0 API (American Petroleum Institute). Sarvak has a thickness of 300 m and it contains oil of $13\text{-}15^0$ API. These two reservoirs are composed of carbonate rocks and may be highly fractured. Preliminary estimations indicate that the amount of oil in place is several billion barrels. Also, a delineation well was drilled, but it did not encounter any expected fractured zone within the Jahrum and Sarvak Formations. A surface fracture study was carried out on this structure. Its results were compared with those from Schlumberger logs and core studies, and indicate a very good correlation. At present, it is believed that periodic steam injection is probably the most suitable recovery method applicable for this field; however, the type of production system and locations for the injection and production wells will be determined after the completion of the present phase of study. Apart from the Kuh-e Mond anticline, a few more heavy oil fields such as Zaqeh, Paydar, and Paydar West have also been discovered. All of these discoveries are located in the southwestern part of Iran. Based on the primary estimations, the total amount of original heavy oil in place discovered in these fields is in the range of 10 billion barrels. 9 figs., 2 tabs.

37943 (AOSTRA–8808, pp. 12) **Occurrence of heavy crude oil in Persian Gulf.** Bashari, A. (Iranian Off Shore Oil Co., Tehran, Iran). Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

Some of the most prolific petroleum reservoirs with high gravity of oil in the world occur in Upper Jurassic and Cretaceous carbonate formations in the Persian Gulf area. Accumulation of heavy oil and natural asphalts on the Iranian side of the Gulf extends from NE to SW of the Qatar arch. Some of the geological structures that are located along the above-mentioned trend contain heavy oil and natural asphalts within post-Jurassic formations. The major geologic factors that caused accumulations of heavy oil within some geological structures are due to the Qatar arch. As a result, some differences appear in lithologic units in the two sub-basins, NW and SE of the arch, repsectively. In general, occurance of heavy oil in this trend can be explained as follows: fracturing and joints within formations; reduction of thickness of post-Jurassic sediments; pinchout, and also facies change of Arab reservoirs in some structure from anhydrite to dolomite and cap rock (Hith nahydrite). The absence of a proper environment for the generation of high gravity oil may also be important. It should be mentioned that the F structure with huge amounts of oil in Ratawi and Sulaiy carbonate reservoirs (lower Cretaceous) is one of the largest heavy oil fields along this trend. The Farsi B structure, with a high thickness of Jahrum formation (Eocene), which has excellent reservoir properties, is filled with natural asphalts. 7 refs., 9 figs., 3 tabs.

37944 (AOSTRA–8808, pp. 12) **The Orinoco Delta, a future exploratory province for heavy and extra heavy oils.** Zamora, L.G. (LAGOVEN, S.A., Caracas 1010A, Venezuela); Gonzalez, L.; Linares, L.M. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

Along the Orinoco Oil Belt, there are four known large Miocene fluviodeltaic depocenters, each located in front of a present day river basin outlet. These river basins are believed to have been the feeders of said depocenters. A fifth Middle Miocene fluviodeltaic depocenter is postulated to exist in the Southern Orinoco Delta area, at the eastern end of the belt, next to the well-known Cerro Negro area. This depocenter, similar to the Cerro Negro depocenter, would have been fed by a river basin occuped today by the Yuruari-Cuyuani system. This system has been draining to the Esequibo since the beginning of the Late Miocene, according to this hypothesis. The proto-Yuruari river basin, as it is here named, would have yielded a volume of sediments of the same order of magnitude, and of the same composition as the sediments in Cerro Negro. Given the geological and petroleum history of the southern flank of the Eastern Venezuela basin, and provided that the southern Orinoco Delta area shared this condition, any accumulations of hydrocarbons would follow the model of the Orinoco Oil Belt. On the basis of this hypothesis, an expectancy of oil in place for the Middle Miocene in the southern Delta has been calculated by probabilistic methods as being from about 4 billion to about 36 billion cubic meters. 10 refs., 8 figs.

37945 (AOSTRA–8808, pp. 20) **Exploratory prospect and prospective areas for heavy and extraheavy crudes in the Eastern Venezuelan Basin, Venezuela (excluding Orinoco Oil Belt).** Acosta de Moreno, Z. (LAGOVEN, S.A., Caracas, Venezuela). Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

During 1986 and 1987, Petroleos de Venezuela, S.A. carried out studies to determine and evaluate areas of exploratory interest for heavy and extra-heavy crudes. In the Eastern Venezuela Basin, the largest basin in the country, oil accumulations have been associated with asphalt and heavy oil seeps. Several wells, drilled in past decades during exploration for light and medium crudes, also indicated the presence of unconventional crudes. This basin covers an area of approximately 164,000 km^2. The oil in place is estimated to be 59×10^9 m^3, and the total reserves of heavy crude between 14 and 21.9 American Petroleum Institute (API) degrees and extra-heavy crude of less than 14^0 API are estimated at 5×10^9 m^3. The basin produces a range of hydrocarbons, from extra-heavy crudes to gas and condensates. Three zones are distinguished within the basin, according to type of hydrocarbons produced. Geologically, it is a typical asymmetric basin affected by compressive forces from the north, which gave origin to folds, a deformation front, and normal faults or distensive zone. 32 exploratory prospects and 3 prospective areas were identified where the hypothetical reserves total 0.268×10^9 m^3. 3 refs., 14 figs.

37946 (CHOA–8711, pp. 32) **Statistically based well log analysis applied to reservoir studies.** Hitchner, J.R. (Geona Enterprises, Ltd.); MacCallum, G.T.; MacCallum, W.E. Canadian Heavy Oil Association (Canada). 1987. (CONF-8709445–: 6. quarterly meeting of the Canadian Heavy Oil Association, Calgary, Canada, 22 Sep 1987;CE–02643). In *Reservoir description. Proceedings [of the] sixth quarterly meeting of the Canadian Heavy Oil Association.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $N/C.

One of the major problems in undertaking regional geologic projects involving the use of digital well log data has been the significant variation in well log response from well to well. Some consistent method of reducing these response fluctations and accentuating the actual geologic tool response is necessary if the log data are to provide useful solutions to geologic problems. Once this optimized or normalized data is obtained, well log response can be statistically investigated. Very significant gains are afforded in enhanced well log analysis methods, improved stratigraphic interpretation and reservoir delineation. This paper introduces the concept of a multiwell contoured frequency cross plot and windowed well log frequency spectra. The use of these computer

assisted analysis tools is discussed to show how lithofacies gradation can be measured and how permeability and irreducible water saturation can be estimated. Analysis results based upon a statistically based log analysis system are then compared to results obtained using more conventional well log analysis techniques and data from five cored wells in the Morgan heavy oil pool area of Alberta. It is shown that methods have now been developed that can consistently build an optimized data set from raw digital data. Statistical processing of the optimized data provides well log analysis programs that derive measurements of lithofacies gradation. All of the conventional reservoir parameters, including permeability, can be tied to lithofacies measurements. The basis for the calculation of irreducible and free water saturations in heavy oil reservoirs has also been established. 20 figs.

37947 (DOE/BC/10850–13) **Geoscience studies with a focus on reservoir heterogeneity in support of the EOR program: Quarterly progress report, July 1, 1988–September 30, 1988.** Wilson, J.L.; Gutjahr, A.L. New Mexico Inst. of Mining and Technology, Socorro, NM (USA). 7 Oct 1988. 6p. Sponsored by DOE Fossil Energy. DOE Contract AC22-85BC10850. Order Number DE89015484/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This quarter work on the Fast Fourier Transform simulation method was continued and the procedure was applied to several problems. One master's paper studied several aspects of the procedure and its use for studying flow phenomena. In the analysis of the variability that can exist in flow problems it would be useful to have theoretical models for flow toward production wells of from injection wells. To that end a simple analytical model for both two and three dimensional flow toward wells has been developed. 5 refs.

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Refer also to citation(s) 37947, 38003, 38004, 38048, 38059, 38060, 38068, 38082

37948 (AOSTRA–1988, pp. 18) **Compositional and viscosity variations in fluids produced from the Husky Tangleflags Fireflood Project.** Erno, B. (Nova Husky Research Corp., Calgary, AB, Canada); Tsang, C.; Saetre, R.; Tsang, P. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

Characterization studies of the oil, brine and gas produced from the Husky Tangleflags Fireflood Project in Saskatchewan are described. Oil of reduced viscosity was produced from several wells over the six month study period. Detailed comparison of the altered oil with native oil found subtle changes in the asphaltene fraction, suggesting that the altered oil has been partially upgraded by thermal cracking. Significant concentrations of C_2-C_5 alkenes found in the produced gases from some wells provided further evidence and some understanding of the role of thermal cracking in the recovery process. The composition of the brine produced from several wells also changed as the fireflood progressed. Dilution and pH lowering were the most significant changes. The lower pH is attributed primarily to the addition of sulphuric acid and acetic acid to the brine. Both acids appear to move through the reservoir in the gas phase (the former as SO_2 or SO_3). More subtle changes were also noted in other species, particularly calcium and magnesium. Correlations between changes in the produced fluids, operational variables, and production problems are discussed. 13 refs., 3 figs., 10 tabs.

37949 (AOSTRA–1988, pp. 16) **Behavior of heavy oil core material under simulated fireflood conditions.** Erno, B. (Nova Husky Research Corp., Calgary, AB, Canada); Tsang, C.; Saetre, R.; Tsang, P. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

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37950 (AOSTRA–1988, pp. 8) **Dialectics of the methods based on in situ oxidizing processes.** Bernshtain, A.M. (All-Union Oil and Gas Scientific Research Inst., USSR); Polkovnikov, V.V.; Bogdanov, I.I. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

Developments in the investigation and utilization of in-situ combustion for thermal recovery of heavy oil in the USSR are reviewed. The technology of in-situ combustion using air as the oxidant was considered widely applicable by the end of the 1960s, yet a number of disadvantages were noted. A new technology, wet in-situ combustion was developed, in which water was also injected along with the air. The water collected unused heat behind the combustion front and transferred it to the unheated part of the reservoir or to the heated zone, thereby increasing the degree of heat utilization. The next step was superwet combustion, in which the temperature in the heat liberation zone is close to steam saturation temperature; a substantial decrease in air/oil ratio is the advantage of this process. Further developments took place in association with conventional waterflooding. The kinetic and hydrodynamic theory behind the various developments is discussed, and current testing of in-situ combustion plus cyclic waterflooding in the Karazhanbas oil field is outlined. 5 refs., 6 figs.

37951 (AOSTRA–1988, pp. 19) **Technology of heavy oil and bitumen recovery. Cyclic stimulation by the energy of electromagnetic field and oxidizing agent injection.** Diashev, R.N.; Chamzin, A.A.; Diblenko, V.P. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

The formulas and results of calculations are presented for the thermal field created by electromagnetic field stimulation of heavy oil wells. Taking into account the small heating depth of the producing formation being stimulated, a complex technology including the subsequent injection of oxidant into the formation is recommended. Preheating of the bottom hole area allows injection of a certain amount of the oxidant into an impermeable formation in order to raise the formation temperature and attain high-temperature oxidation, and also to create an energy resource for subsequent production from the same well. Field tests in the Soviet Union have confirmed the effectiveness of this technology, and some test results are presented. 11 refs., 13 figs., 3 tabs.

37952 (AOSTRA–1988, pp. 12) **Design features of a high-pressure compressor for in situ combustion plant for extraction of high viscosity crude in India.** Dwivedi, S.N. (Bharat Pumps & Compressors Ltd., Naini, Allahabad, India). Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

In situ combustion for the extraction of high viscosity crude is being tried for the first time in India at pilot plant level. The process involving in situ combustion with a continuous stream of high pressure air injected into four equidistant wells, requires a very reliable high pressure air compressor. This paper presents the salient design features of this special-purpose compressor delivering air at a discharge pressure of 150 kg/cm^2. The compressor has suction and discharge dampeners on all five stages, gas coolers on each stage discharge, and separators of the vane pack type after each gas cooler. Valves are of double mechanical damping design so as to ensure reduction in pressure drop through the valves and the consequently enhanced efficiency of the compressor. 12 refs., 8 figs.

37953 (AOSTRA–1988, pp. 26) **Analytical analysis of air/oxygen wet combustion by energy balance.** Chiu, K.W. (Dome Petroleum Ltd.). Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

This paper presents a novel analysis of air/oxygen wet combustion. The analysis is substantially different from existing analytical heat transfer studies and is capable of predicting the burned zone and steam zone volumes, temperature rise, saturation changes, oil production rate, and water cut for a 5-spot or 7-spot pattern configuration. Instead of solving complex multi-phase fluid flow and energy equations, the model is developed based on energy balance using measured data from combustion tube experiments, and basic reservoir and fluid properties. Heat loss to the overburden and underburden is determined using the Marx-Langenheim solution. The size of steam zone is determined based on the convective heat transfer, which also includes heat transfer from the steam zone to the unburned zone. The relative permeability data are used to determine oil production rate and water cut. With results showing excellent agreements with published laboratory results, the model presented in this paper can be used as a design tool for in-situ combustion field projects and for optimizing the water-air ratios for wet combustion. Predicted combustion performance for projects of various pattern size, net pay, areal sweep efficiency, and oxygen content are also included. 19 refs., 20 figs., 2 tabs.

37954 (AOSTRA–1988, pp. 12) **A nomographic technique to predict the scaling tendency of anhydrite and gypsum.** Wiwchar, B. (Alberta Research Council, Edmonton, AB, Canada); Gunter, W.D. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

The majority of in-situ recovery techniques currently under investigation in tar sand and heavy oil reservoirs rely on the injection of steam or hot water into the formation. These fluids continuously mix with the formation waters and react with the mineral phases present, becoming increasingly saturated with dissolved solids. they proceed through the reservoir. In cyclic steam injection processes, these fluids must return to the hot injection well bore where they may become supersaturated with respect to certain minerals. Two such minerals which may potentially precipitate in the well bore are anhydrite and gypsum. A nomographic technique is presented to predict the formation of anhydrite brines. A saturation index is calculated which indicates the degree of saturation of anhydrite and gypsum in solution. Saturation indexes calculated by this method are compared to the computer code SOLMNEQ. The technique is valid up to 300^{0}C. This method treats the effects of complexed species in solution in NaCl brines. In other brines, this technique will prematurely predict scaling if strong complexing is present. The method is otherwise reliable and easy to use. 14 refs.

37955 (AOSTRA–1988, pp. 13) **Applications of SOLMINEQ.88 and SOLMINEQ.88 PC/SHELL to thermally enhanced oil recovery.** Perkins, E.H. (Alberta Research Council, Edmonton, AB, Canada); Gunter, W.D. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

The reactions between waters, minerals, oil and gases in oil reservoirs and well bores during thermal recovery consists of a combination of many different processes. Because these processes cannot be observed directly, geochemical modelling based on equilibrium thermodynamics is a well recognized tool for understanding them and predicting their consequences. SOLMINEQ.88 is a program which can model these and many other different process. SOLMINEQ.88 PC/SHELL is a proprietary user friendly interface to SOLMINEQ.88. It allows easy input data entry (complete with error checking), graphical analyses of output, an interactive shell which controls the running of SOLMINEQ.88, and several utility functions. It is designed to be run on a IBM personal computer or compatible using the DOS operating system. The operation and usefulness of these programs is illustrated by using chemical analyses from boiler feed waters, production waters and wastewaters and predicting a number of processes. 8 refs., 6 figs., 3 tabs

37956 (AOSTRA–1988, pp. 10) **A review of in-situ combustion mechanisms.** Moore, R.G. (Univ. of Calgary, AB, Canada); Bennian, D.W.; Ursenbach, M.G. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

In-situ combustion is an enhanced recovery process for heavy oil and tar sands with great theoretical potential but a poor track record in the field. This lack of success can be attributed to the limited understanding of the complex processes, such as multiphase flow, heat and mass transfer and low and high temperature combustion, which are simultaneously taking place in the reservoir. Many important insights into these processes have been gained at the Department of Chemical and Petroleum engineering at the University of Calgary, where research into in-situ combustion has been ongoing since 1974. These results have been drawn from over 200 combustion tube test runs and from supporting work in the areas of oxidation and thermal cracking kinetics, ignition, fluid flow in porous media, relative permeability and the effects of clay and water in the reservoir. This paper outlines the major contributions this program has made towards a better understanding of in-situ combustion mechanisms. 40 refs., 1 fig.

37957 (AOSTRA–1988, pp. 14) **Experimental study and kinetic modelling of crude oil pyrolysis in relation to thermal recovery processes.** Behar, F. (Inst. Francais du Petrole, Rueil, France); Ungerer, P.; Audibert, A.; Villalba, M. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

Knowledge of oil cracking kinetics is necessary in oil production for thermal methods of enhanced oil recovery. This work aims at studying cracking of an aromatic oil (Boscan) and a paraffinic oil (Pematang), in order to compare their reactivity in terms of gas, liquids and coke formation. Experiments were carried out in a closed system, over a large range of heating times (few minutes to 1 month) and temperatures (335 to 540 ^{0}C). Results show that longer heating times compensate the effect of lower temperatures for Boscan oil. This is not the case of Pematang oil, for which greater proportions of condensate are generated at low temperatures. Molecular hydrogen is present in negligible amounts, and important cracking of the condensate fraction is reached at 450^{0}C, 3 h while the cracking of the C2-C5 compounds occurs at 500^{0}C, 9 h. As thermal cracking increases, asphaltenes disappear rapidly, followed by saturates and unsaturates (C14+). Consequently, the residual C14+ fraction is composed mainly of polyaromatic structures. At the onset of thermal cracking, coke production can be related to the rapid decrease of asphaltene content. Thus, the final coke yield depends only on the further evolution of the intermediate fractions (C2-C5, C6-C13,C14+extract). A kinetic model describing the evolution of C14+, C6-C13, C2-C5, C1 and coke has been elaborated on the basis of these experiments. This model accounts satisfactorily for the quantitative distribution of pyrolysis products of each oil, over a large range of tempertures and heating times. 23 refs., 6 figs., 6 tabs.

37958 (AOSTRA–1988, pp. 16) **The effect of recovery processes on the characteristics of the produced heavy oil.** Jha, K.N. (CANMET, Ottawa, ON, Canada); Lafleur, R.; Sawatzky, H.; Verkoczy, B.; Soveran, D.; Reichert, C.; Fuhr, B. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

The chemical, physical and asphaltic characteristics of three heavy oils from the Eyehill reservoir in Saskatchewan (one produced from a primary well and two from in situ-combustion wells) have been determined. The results indicate that there are significant differences in the density, viscosity, sulfur contents, carbon residues and distillation fractions (naphtha and middle distillates) between the primary and in situ combustion (tertiary) oils. The naphtha fraction shows that the aromatic content in the tertiary oil is approximately four times more than in the primary oil. The gas chromatograph coupled mass spectrometric analyses demonstrate that some new compounds, not present in the primary oil, are produced in the tertiary oil. For the heavier fractions (gas oil and residue) there were little apparent differences indicating that the thermally produced lighter fractions are distilled ahead of the firefront. Large differences in the physical properties and chemical composition were observed in the oils obtained from two fireflood wells. The changes in composition of the produced oil caused by the in situ combustion process could have profound effects on the quality of the oil. The results and their implications are discussed. 6 figs., 9 tabs

37959 (AOSTRA–1988, pp. 16) **Behavior of heavy oil core material under simulated fireflood conditions.** Verkoczy, B. (Petroleum Division, Saskatchewan Research Council, Regina, SK, Canada); Jha, K.N. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

Preserved cores and produced oils obtained from five Saskatchewan heavy oil reservoirs were examined for their thermal behavior in air and nitrogen using thermoanalytical techniques. The results indicate that the thermal reactivity of oil in the in-situ combustion process depends on the oil-matrix interaction at or near the combustion front, the degree of oxidation of oil and to a lesser extent the composition of oil. Data from nitrogen tests show that some of the cores do not produce coke which seems to indicate that in suh reservoirs the firefront is maintained largely by combustion of the pyrolyzed products of the heavy oil residue. Thermal gravimetric investigation of the separated neat samples of oil constituents, saturates, aromatics, resins and asphaltenes (SARA), in air and nitrogen led to the estimation of the oxygen distribution into these fractions. Subsequently the contribution of the SARA fractions to coke formation was also calculated and compared to the coke formation in the whole oil. During a study of the isothermal oxidation reactions of cores in a steady state plug flow reactor, it was observed that when the effluent gases O_2, CO and CO_2 were passed through a short, cold segment of the reactor packed with core the concentration of CO decreased and that of CO_2 increased. Oil components contributing to fuel lay down, an interpretation of fuel lay down versus fuel utilization, as well as the possible fate of carbon monoxide in the field or in the combustion tube, are discussed. 10 refs., 8 figs., 9 tabs.

37960 (AOSTRA–1988, pp. 7) **A paper on steam distribution, control and metering systems.** Holcek, R.G. (Delta Projects, Inc., Calgary, AB, Canada). Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

The experience of steam injection for the recovery of heavy oil on a commercial basis in Alberta has been based upon design considerations that take into account Alberta's climatic and environmental conditions. Some of the design installation, and heat loss considerations predominantly used are described. Central steam generation facilities are used for the distribution of high pressure steam to injection wells, and are located at the same site with the oil and water treating facilities. Lines for the distribution of high pressure steam are normally installed above ground. The use of multi-wells directionally drilled from a central pad has minimized the amount of high pressure steam lines that have to be run and the land use requirements. Lack of mobility around the plant site is therefore not a problem. Calcium silicate insulation is used to minimize heat losses in the steam lines since it has good thermal insulting properties and resists mechanical damage. Measurement of high pressure steam to injection wells is accomplished by flow nozzles, and either manual or auomatic control is used for distribution of high pressure steam to injection wells. 1 ref., 3 figs.

37961 (AOSTRA–1988, pp. 14) **Combining steam drive technology and small nuclear steam plants with reference to Shengli oilfield, China.** Froehling, W. (Univ. of Duisburg); Juelich, K.F.A.; Kugeler, K.; Stoll, R.D.; Schwarzkopp, F.; Daxin, Z. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

In recent years, experience has been gained with large steam-drive projects operating at several hundred tons of steam per hour. Parallel to these efforts, increasing importance is attributed by the nuclear industry to the generation of process heat, mainly in the form of process steam. For many of these applications, the size of conventional nuclear power stations is not appropriate. Therefore, small units with a high safety standard and steam generation capacities in the range of 250 to 350 tons per hour have been developed. Several of these units can be coupled to achieve the desired total steam capacity. This has fostered the idea of substituting nuclear energy for fossil fuel to generate oilfield injection steam, using a high-temperature reactor (HTR). Both oil recovery by steam drive and nuclear steam generation are well researched technologies, but their combination poses some important questions concerning matters such as steam transportation and distribution, safety, availability of generated steam, reservoir requirement, and

economic prospects. Related studies performed by research institutes in West Germany, and Beijing, China, are outlined. Shengli Oil of China has selected the Shanjasi section of the Shengli oilfield as the reference field, for a HTR project. Some numerical simultion results are presented. 2 refs., 6 figs., 7 tabs.

37962 (AOSTRA–8808, pp. 11) **High viscosity oil recovery from carbonate reservoirs by thermal methods.** Antoniadi, D.G. (Research and Production Association Soyuztermneft, Krasnodar, USSR); Garushev, A.R.; Budnikov, V.F. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

A number of pilot and semi-commercial projects for the thermal recovery of oil from carbonate fractured porous reservoirs by in situ combustion and steam stimulation have been carried out in the USSR. It is proved that, in carbonate reservoirs, the development of the in situ combustion process generally takes place in a macroporous region of the reservoir; heat is not transferred to the microporous regions of the reservoir. A macroporous region of the reservoir serves as a channel for a fast breakthrough and an explosive concentration of oxygen-hydrogen mixture is produced, as was observed in the Borovskoye and Usinskoye oil fields while the in situ combustion process was being initiated. Laboratory and field research of in situ combustion in micro- and macroporous reservoirs is continuing. The cyclic steam stimulation of wells is recommended for the recovery of high viscosity oil from carbonate micro- and macroporous reservoirs in the first stage. Pattern cyclic steam stimulation is recommended for the heating and displacement of oil from microporous to macroporous regions in the second stage. In the third stage, after this displacement, its further advance through the formation can be assisted by cold or hot water and other hot agents. The pattern of wells, local or in rows, should be considered to assess the feasibility of the various processes. 1 ref., 8 figs., 1 tab.

37963 (AOSTRA–8808, pp. 14) **Application of heat carriers upon development of high-viscous heavy oil fields in the USSR.** Boxserman, A.A. (All-Union Oil and Gas Scientific Research Inst.); Tarasov, A.G.; Antoniadi, D.G.; Dzhalolov, K.E.; Larrennikov, V.A. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

This paper concerns the basic principles of heavy oil fields development in the USSR. Use of a steam injection followed by waterflooding in terrigenous reservoirs considerably reduces thermal agent consumption for oil production. This is illustrated by the Okla oil field in Sakhalin island, and by other oil fields. The cyclic thermal stimulation technique in carbonate reservoirs increases oil rates and decreases energy consumption for oil production. This is illustrated by the Usa oil field in northern USSR. Mathematical models for production forecast in the presence of heat carriers injection are validated. 5 refs., 10 figs.

37964 (AOSTRA–8808, pp. 4) **Development of a practical steam injection simulator.** Zhai, J. (Research Inst. of Petroleum Exploration and Development (RIPED), Beijing, People's Republic of China); Shang, H.; Cheng, Y. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

This paper describes the development and application of a practical steam injection model in China. The numerical model simulates hot water injection and steam injection in either Cartesian or radial geometry. The simulator employs the D4 Gaussian elimination method to solve the matrix of a finite difference equation. An adaptive correction iteration method is used to accelerate convergence and a local nine-point difference scheme is used to reduce the effects of grid orientation. The simulator is fast, reliable, and stable. It can be run on an IBM-PC/AT. 7 refs., 1 fig., 2 tabs.

37965 (AOSTRA–8808, pp. 18) **A cyclic steam stimulation model for heavy oil reservoirs.** Gozde, S. (Mobile Oil Canada Ltd., Calgary, AB, Canada); Chhina, H.S.; Best, D.A. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

Cyclic steam stimulation is a common process used for recovering heavy oil and it normally precedes steamflooding. This paper presents a cyclic steam stimulation prediction model that can be used for both pressure depleted reservoirs and reservoirs with initial oil mobility and drive energy. The model is a modification of the Gontijo-Aziz model for pressure depleted reservoirs. The heated zone volume has been modified to include heat loss from the reservoir during injection. The water and oil saturations are calculated independently, based on a material balance on each phase. The oil flow from the cold zone into the heated zone, or vice versa, is calculated and accounted for in both the material balance and the energy equation. The flow potential takes into account both the gravity potential and the pressure differential within the heated zone. The overburden heat loss model accounts for both heat from the reservoir to the cap rock or vice versa. The relative permeability curves have been made more general for ease of history matching. The model has been validated against two field test examples and has been compared to the results from thermal simulation on the cyclic steam stimulation case problem from the fourth Society of Petroleum Engineers comparative study of steam injection simulators. 17 refs., 13 figs., 9 tabs.

37966 (AOSTRA–8808, pp. 9) **Numerical simulation of alkaline/cosurfactant/polymer flooding.** Islam, M.R. (Nova Husky Research Corp., Calgary, AB, Canada); Farouq Ali, S.M. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

This paper presents a new mathematical formulation that provides a representation of surfactant-enhanced alkaline and alkaline/polymer processes for enhanced oil recovery. Unlike previous approaches, the model accounts for transient interfacial tension and nonequilibrium mass transfer phenomena. Laboratory experiments have suggested that, at ultralow interfacial tension (IFT) values, oil recoveries become sensitive to transient IFT values. The presence of polymer affects slightly the dynamic IFT behavior and delays the time required to attain an equilibrium IFT. The proposed model uses the Langmuir model for adsorption. Also considered are the resistance factor and the modification in transient IFT behavior due to the presence of polymer. Numerical results have been compared qualitatively with experimental data. Even though the results presented here are for one-dimensional flow, the generalized model equations can be used for multidimensional simultion. The results showed that the new model can be used to investigate the displacement mechanisms. The model showed its sensitivity to initial alkali/co-surfactant and polymer (A-S-P) concentrations in A-S-P injection. For the cases studied, polymer concentrations of 0.05% and alkali concentration of 0.1% appeared to optimize oil recovery. The model also showed the sensitivity of the process to the oil/water viscosity ratio. 14 refs., 9 figs., 1 tab.

37967 (AOSTRA–8808, pp. 18) **Modelling of smectite synthesis in reservoir sands. Comparison of path predictions to autoclave experiments.** Gunter, W.D. (Alberta Research Council,

Edmonton, AB, Canada); Bird, G.W.; Aggarwal, P.K.; Leone, J.A. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807--: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE-02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

A reservoir sand containing a variable clay fraction composed predominantly of kaolinite with some illite and minor chlorite and smectite, was reacted in a synthetic seawater at temperatures up to 232^{0}C in autoclave runs up to three months long. In the higher temperature experiments, the fluid composition changes with time; dissolved total inorganic C (TIC), Si, and Fe show a strong increase while pH, Mg, and SO_4 decrease. These changes in water chemistry can be correlated with strong smectite growth. The 232^{0}C autoclave experiments were modelled with the computer program PATH. In the computer model runs, the kinetic factor (relative rate of dissolution of each mineral in the reservoir sand) was used as an adjustable parameter to match the experimental history. All PATH runs eventually exhibit strong smectite growth that matches the autoclave results. The best fit to the autoclave experiments was obtained by allowing rapid dissolution of quartz. Although the predicted water compositions do not superimpose on the measured water compositions, they follow the same trend as the measured water compositions but appear to be more evolved. Although an acceptable fit to the autoclave data was obtained, large uncertainties exist in the model predictions that cannot be resolved until experimentally determined rate laws are available. Currently, computer programs such as PATH should only be used as screening tools to predict formation damage. 7 refs., 9 figs., 5 tabs.

37968 (AOSTRA-8808, pp. 21) **The influences of alkaline steam injection on the physical properties of formation rock and proppants.** Whitney, S. (Univ. of Oklahoma, OK, USA); Tiab, D. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807--: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE-02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

This report discusses the results of extensive laboratory testing and analysis of the effects of alkaline steam injection on the physical properties of formation rock and propping materials at high temperature and pH conditions. The materials tested are Ottawa sand and Bauxite group proppants. Sodium hydroxide solution was used to vary the pH of the injection steam, which was maintained at 80% steam quality. Injection temperatures used were 148.8, 204.4, and 232.2^{0}C. The rate of silica dissolution was shown to be dependent on pH and temperature. As the temperature and pH increased, the silica dissolution increased, and as the temperature increased, the dependence of the reaction on pH decreased. For sintered bauxite, the dissolution of silica showed that the silica available is limited and that the removal of aluminum oxide is dependent on silica dissolution. The intermediate strength proppant behaved like the Ottawa sand, as if the silica available for reaction were continuously in excess, despite continuous removal. The strength of the materials exhibits a spatial dependence where the primary damage is in the influent region of the test cell for all materials. Ottawa sand has the most fractional strength loss under the given test conditions and sintered bauxite has the least fractional strength loss. This is also reflected in the examination by scanning electron microscopy. The generation of fines during standard American Petroleum Institute strength testing showed increased fines generation, upon stressing, for increased silica dissolution. Pressure analysis of the system showed a decreasing effective permeability to steam for all tests. 30 refs., 21 figs., 6 tabs.

37969 (AOSTRA-8808, pp. 16) **Laboratory study of formation damage during steam injection.** Jianshe, W. (RIPED, Beijing, People's Republic of China); Li, X.; Zhang, X. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807--: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE-02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

Heavy oil structures are more likely to be found in poorly cemented or unconsolidated sandstones. Since unconsolidated rocks expose more reactive sites of clay and consist of considerably finer particles, clay swelling leading to dispersion and fines migration are more severe. This paper describes a laboratory procedure adopted in China to identify potential formation damage and to evaluate clay stabilizers. The results indicate that clay sensitivity suggested by the core flooding test is significant only when cores are properly prepared. Some encouraging data show that the organic cationic polymer TDC-15 can be used as a formation stabilizer in steaming projects. 15 refs., 19 figs., 3 tabs.

37970 (AOSTRA-8808, pp. 14) **Laboratory study of permeability reduction due to the flow of kaolinite fines.** Ceda, C.M. (Alberta Research Council, Edmonton, AB, Canada); Non-Chhom, K. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807--: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE-02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

Permeability damage due to fines migration can lead to a considerable loss of reservoir productivity. This study was carried out to determine the conditions that affect the reservoir permeability during the flow of kaolinite fines. Suspensions of kaolinite were injected into clean sandpacks and the permeability reduction was monitored as a function of pore volumes of fines suspension throughout. The influence of electrolyte concentration, pH, and initial permeability was then determined. The rate of permeability reduction showed a strong dependence on the chemistry of the injected aqueous suspensions when the initial permeability was high (20 μm^2). High rates of permeability reduction were observed at low pH and at high electrolyte concentration. In contrast, low rates were observed at low electrolyte concentration (below 10^{-2} M) and basic pH. The above trends were not observed when the permeability of the porous formation was low (10 μm^2). Very similar permeability reduction rates occurred at all electrolyte concentrations and pH. Thus, there exists a critical initial permeability below which the damage due to the flow of fines is independent of the water chemistry. Theoretical calculations of the colloidal forces between sand grain surfaces and kaolinite fines provided the basis for interpreting the experimental data. Most of the experimental results were in good agreement with predictions and are discussed in terms of their implications for oil reservoirs containing an appreciable amount of fines. 16 refs., 8 figs., 4 tabs.

37971 (AOSTRA-8808, pp. 12) **Chemical viscosity reduction to improve steam stimulation performance.** Current, S. (Chevron Research Co., Richmond, CA, USA). Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807--: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE-02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

Steam injection is widely practiced as a method to increase the recovery of heavy oils throughout the world. Production is improved primarily by heating and reducing the viscosity of the oil, however steam injection also has the potential to increase viscosity by the formation of water-in-oil emulsions during injection and as the steam condenses in contact with the oil. A proprietary surfactant, CHASER CS1010 Cyclic Steam Additive, was found that lowers the viscosity of a wide range of crude oil emulsions. Viscosity reductions up to 75% were measured in a laboratory test. In field applications, the effect of CHASER CS1010 addition during steam stimulation reanged from no detectable effect to greater than a 100% improvement in oil production. Field results have averaged

between 20 and 60% improvement in oil production under a variety of reservoir conditions. 5 refs., 4 figs., 5 tabs.

37972 (AOSTRA–8808, pp. 20) **An experimental and numerical study of blocking of a mobile water zone by an emulsion.** Islam, M.R. (Nova Husky Research Corp.); Farouq Ali, S.M. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

This paper examines the blocking mechanism of a water zone underlying an oil zone by use of an emulsion, to increase waterflooding efficiency. Recent studies have shown that a possible means of improving waterflood efficiency would be to precede the waterflood with a slug of a mobility control agent, particularly a carefully selected emulsion. This paper investigates, both experimentally and computationally, the flow mechanism of emulsions as blocking agents, as well as their effectiveness in controlling mobility while waterflooding an oil reservoir both with and without a bottom-water zone. The stability of oil-in-water emulsions in a porous medium is discussed. In the presence of a bottom-water zone, it is shown that the blocking action of emulsions would depend not only on their oil content but also on the reservoir and fluid properties, such as oil-to-water zone thickness and permeability ratios, oil viscosity, emulsion slug size, etc. A novel approach was developed for simulating the flow of an emulsion in a porous medium. Numerical simulation results are presented for emulsion flow in an oil reservoir with a bottom-water zone. Experimental evidence suggests that emulsion flows as an independent phase in the presence of oil and water, and that the process may be treated as a 3-phase flow. However, the absolute permeability is affected only by the presence of the emulsion. This information was used in numerically simulating emulsion blockage within a three-dimensional, 3-phase flow framework. Good agreement was obtained between numerical and experimental observations. 9 refs., 22 figs., 2 tabs.

37973 (AOSTRA–8808, pp. 8) **West Urdaneta heavy oil field exeriences in gas lift troubleshooting.** Cordero, O. (Petroleos de Venezuela, S.A., Caracas, Venezuela); Zimmerman, W. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

The exploitation of the West Urdaneta Oil Field, located along the western coast of Lake Maracaibo, Venezuela, is considered a challenge because of its offshore location, the nature of the crude (10-12 American Petroleum Institute gravity, 180 poise viscosity at 90^{0}F), and well depths averaging 8100 ft. During the development of the field, different lifting methods were evaluated, such as sucker rod and hyraulic pumping and gas lift. Based upon the best production rates and lowest production costs, a new gas lift technique developed by LAGOVEN S.A. was selected. The main problem experienced while trying to produce the wells by the continuous gas lift method was the foam formation. On the other hand, when trying to use intermittent gas lift in order to avoid the foam formation, the flow became continuous because of the high productivity index and high bottom hole pressures of the wells. Extensive field testing proved the slug flow gas lift technique, a variation of the intermittent gas lift method, to be the most efficient. The production optimizing process of each well produced by this method requires the application of diagnostic theory to identify the flow regime and evaluate the well's performance, allowing precise determination of the optimum volume of gas lift required to assure maximum production. This paper describes the troubleshooting techniques for the slug flow gas lift method through case histories, and discusses the theoretical basis and the calculation procedure used to obtain numerical solutions. 10 refs., 5 figs.

37974 (AOSTRA–8808, pp. 8) **Substantial rig time reductions by combined utilization of cyclic steam injection and gas lift in extraheavy oil production.** Yibirin J.; McGee, J.H.; Gallardo, B. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

This paper discusses rig time reduction in a project considered to be unique because, for the first time, extra-heavy crude (density 8.5 degrees by the American Petroleum Institute) with high viscosity at reservoir conditions (20 to 60 poise) has been successfully produced by gas lift in combination with cyclic steam injection. The project consists of 17 wells and is located in the Jobo field in eastern Venezuela, adjacent to the Orinoco Oil Belt field. The paper discusses design criteria of the wells, equipment, operational aspects, field results, and the first two cycles of steam injection and production. Preliminary results have demonstrated both the technical feasibility of gas lifting extra-heavy crude and substantial rig time reductions as compared to rod pumping. The well completion used was successful in withstanding drastic temperature changes during the two production/injection cycles analyzed. Rig and surface equipment maintenance time reductions were in the order of 213 days and 2860 man hours respectively. The termination of the production cycles could be precisely determined from the reservoir temperature decline curve built from flowing bottom-hole temperature data. The method of gas lifting extra-heavy crude is therefore one of the most promising production alternatives for the commercial development of the Orinoco Oil Belt field. 3 refs., 5 figs., 3 tabs.

37975 (AOSTRA–8808, pp. 15) **Application of pump-off controllers in Maraven's heavy oil fields.** Urribarri, G. (MARAVEN, S.A., Lagunillas, Zulia State, Venezuela); Urribarri, O.; Toarres, I. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

MARAVEN's heavy oil fields in the Bolivar coastal area of Lake Maracaibo are produced by beam pumping wells, the reservoirs being depleted by pressure depletion and compaction. Both mechanisms are accelerated by applying the steam soak process. This process is characterized by rapid changes in the inflow performance of producing wells, resulting in conditions whereby the pump capacities exceed the inflow potential of the wells. Such wells require hoist entries to adapt the pump size to bottom-hole conditions. However, due to constraints of hoist availability, wells frequently operate close to or at pump-off conditions, thereby increasing the frequency of damaged well equipment. During the last seven years, MARAVEN has tested various types of pump-off controllers and subsequently has successfully conducted a pilot test of 20 wells utilizing the rod load measurement type pump-off controller. Such controllers were found to be the most appropriate type for the operations of MARAVEN's pumping wells. This type achieved savings in energy consumption of some 40% at the same production level. Based on the successful completion of this pilot project, a large scale pump-off controller project was started, involving 175 wells, of which 60 were equipped with a Supervisory Control and Data Acquisition System, with the objective of reduced operating costs. 11 figs., 4 tabs.

37976 (AOSTRA–8808, pp. 12) **Artificial lifting and automation methods for producing heavy crudes.** Brunings, C. (Petroleos de Venezuela, S.A.); Moya, J.; Morales, J. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

The need to obtain a model for use in the evaluation of pumping units and downhole equipment in heavy oil wells, resulted in the development of an applicable design and optimization technique. All

existing models are based on parameters related to wells and equipment for light and medium crudes. This paper presents the results of adaptations and improvements made to an existing conventional model, making it applicable to heavy crudes. An automated analysis of field performance in heavy oil pumping wells is also presented. The model presented (Bomec) is based on correlations generated from traditional sucker rod design methods; however, it includes several field factors (friction, flotability, etc.) especially suited for heavy and extra-heavy crudes. A comparison was made with other models available in the industry, and favorable results were obtained. Also, the automation of the artifical lift operations was developed as a pilot project in order to monitor four wells in a cluster within the Orinoco Heavy Oil Field in Venezuela through a telemetry system. Remote control of sucker rod systems appears to have several advantages such as permanent supervision of a pumping unit, monitoring of preventive maintenance requirements, and close observation of the well behavior. The results of this pilot project are encouraging, and a study is underway to expand the telemetry system to include more wells from the same heavy oil field. 6 figs., 4 tabs.

37977 (CE–02599, pp. 14) **A simple method for predicting production of a single well test in oil sands and its implications for optimization of thermal recovery.** Saltuklaroglu, M. (Mobile Oil Canada Ltd., Calgary, AB, Canada). Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

During a "huff and puff" type single well test, the oil sands are steam-stimulated by cyclic injection of "slugs" of steam. At each cycle, the production is a function of the heated volume of the oil sands. However, the mobile oil within the heated volume cannot be produced at once. During the production period, the heated volume cools and the mobility of the oil within it decreases. As a result, only a part of the oil mobilized by steam injection is produced. A simple method relating the producible oil to the oil mobilized at the end of the steam injection is proposed as a means of predicting production of a single well test in oil sands. The method accounts for the oil saturation and mobility changes during the cycle. As such, it implies the limitations of "huff and puff" type thermal recovery and suggests ways for optimization. The method has been applied to oil sands in different formations in Alberta. It was confirmed that the volume of oil sands heated and the degree of heating are the major factors that control the oil production in cyclic steam stimulation. The results of the method agree reasonably well with those of the field and computer simulation studies. In addition to indicating the degree of sensitivity of oil production to the parameters of the problem, it suggests that bitumens/heavy oils that can be effectively mobile at relatively low temperatures can be produced with better recovery factors. However, the first cycle recovery would not be expected to exceed 50% of the mobile oil saturation at injection temperature. It also suggests that steam drive would have a higher recovery factor than cyclic steaming, the upper limit being the mobile oil saturation at injection temperature. 10 refs., 5 figs., 2 tabs.

37978 (CHOA–8709, pp. 21) **Planning a commercial scale heavy oil project.** Elder, P.W. (Delta Projects, Inc., Calgary, AB, Canada); Holcek, R.G. Canadian Heavy Oil Association (Canada). 1987. (CONF-8709445–: 6. quarterly meeting of the Canadian Heavy Oil Association, Calgary, Canada, 22 Sep 1987;CE–02642). In *Surface facilities optimization program. Proceedings [of the] fifth quarterly meeting of the Canadian Heavy Oil Association.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $N/C.

The major components which form part of an in-depth engineering study/development plan for a commercial scale in-situ heavy oil project are reviewed. Factors addressed include: technical considerations such as production facilities, water reuse and management, oil/water separation, and heat integration; and economic considerations such as economies of scale, plant phasing, plant staging, and location of high pressure steam generation facilities. Although the requirements for different projects may be similar, each project must be individually evaluated in order to arrive at the most feasible development scenario.

37979 (DGMK–343-2) **Interactions of drilling muds and stimulation fluids with formation rocks. Final report.** Albertsen, M.; Riecke, H.G. Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.). Sep 1988. 48p. (In German). Available from Copy held by UB/TIB Hannover.

Satisfying permeabilities of the pay zone are essential for the oil and gas production and must be protected against damage by unsuitable drilling muds or stimulation fluids. Formation damage can result from uncontrolled mechanical and chemical interactions between fluids and rocks. In praxis there are general formulations for permeability saving fluids available. But, a systematical analysis of the whole subject is missing up to now. This study aims to comprime and interprete the results of selected publications. The objective is to help interested people to enter into the problem, and in addition, to contribute to the initiation of extending research in this important area. (orig.).

37980 (DOE/BC/10850–16) **Geoscience studies with a focus on reservoir heterogeneity in support of the EOR program: Quarterly progress report, January 1, 1989–March 31, 1989.** Wilson, J.L.; Gutjahr, A.L. New Mexico Inst. of Mining and Technology, Socorro, NM (USA). 10 Jul 1989. 25p. Sponsored by DOE Fossil Energy. DOE Contract AC22-85BC10850. Order Number DE89015487/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

During this period, work proceeded on use of the Random Field generation techniques in some studies of non-stationary flow problems, some simulations were made of flows in well fields, and work proceeded on development of a multi-grid algorithm to solve flow problems with heterogeneities. 9 refs., 4 figs.

37981 (DOE/BC/14246–T2) **Microbial field pilot study: Quarterly progress report, March 1, 1989–June 30, 1989.** Knapp, R.M.; McInerney, M.J.; Menzie, D.E.; Chisholm, J.L. Oklahoma Univ., Norman, OK (USA). 18 Jul 1989. 8p. Sponsored by DOE Fossil Energy. DOE Contract FG22-89BC14246. Order Number DE89015479/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The objective of this report is to perform a microbially enhanced oil recovery field pilot test in the Southeast Vassar Vertz Sand Unit (SEVVSU) in Payne County, Oklahoma. Indigenous, anaerobic, nitrate-reducing bacteria will be stimulated to selectively plug flow paths which have been preferentially swept by a prior waterflood. This will force future flood water to invade bypassed regions of the reservoir and increase sweep efficiency. Experiments are underway to determine the influence of permeability, pore throat size, and porosity on bacterial movement within porous media. The penetration rates of two motile Escherichia coli strains, as well as two nonmotile strains, are being compared for their ability to penetrate cores consisting of uniformity packed glass beads. To establish if gas production has an effect at differing pore throat sizes, each strain will be compared either under a condition which supports gas production for both wild type strains only (i.e. fermentation), or one which does not result in gas production from any strain (i.e. nitrate-reducing conditions). Research progress on mathematical modeling, core flooding and field experiments is also briefly discussed. 2 refs., 3 figs.

37982 (DOE/EIA–0265(78)) **Comparative analysis of 1978 crude oil and natural gas production data by state.** USDOE Energy Information Administration, Washington, DC (USA). 23 Mar 1981. 28p. Sponsored by DOE Management & Administration. Order Number DE89014996/JAW. Available from NTIS, PC A03/MF A01 - GPO - OSTI; GPO Dep.

The Energy Information Administration (EIA) developed Form EIA-23, "Annual Survey of Domestic Oil and Gas Reserves," to obtain a credible and reliable base of domestic crude oil and natural gas reserves data. The Form EIA-23 program is managed by the Office of the Oil and Gas Information System (OGIS) under the EIA's Assistant Administrator for Program Development. The 1978 Form EIA-23 was mailed to a statistically selected sample of approximately 3,000 operators of oil and/or gas wells. The total operator

frame numbered about 16,000 operators. Operators were selected based upon their estimated 1978 production. Table 1 summarizes the operator categories; Table 2 summarizes the 1978 Form EIA-23 survey response. Although not the prime focus of the Form EIA-23 data collection program, the reported production data serve a critical function. Because reserves estimates can vary greatly due to judgmental decisions, the more precise production volumes serve as an important measure of survey coverage. This report provides a comparison of the Form EIA-23 production data with data previously published by the EIA Office of Oil and Gas Statistics (OOGS), the American Petroleum Institute (API), the American Gas Association (AGA), and the Bureau of the Census. 3 refs., 11 tabs.

0204 Processing

Refer also to citation(s) 37859, 37871, 38072

37983 (AOSTRA–1988, pp. 10) **Microbial desulfurization of crude oil.** Foght, J.M. (Univ. of Alberta, Edmonton, AB, Canada); Fedorak, P.M.; Westlake, D.W.S. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

The observation that some microorganisms can oxidize specific classes of organic molecules such as sulfur heterocycles suggests that microbial desulfurization of crude oil is possible. Current approaches rely on oxidation of sulfur compounds to polar metabolites that can be water-washed from the oil. Bacteria capable of oxidizing sulfur heterocycles were isolated from environmental sources including oil sludge landfarming sites. The oxidation of dibenzothiophene (DBT; a model sulfur heterocycle found in crude oil) was measured by gas chromatography using a sulfur-specific detector, and by spectrophotometry. The water-soluble metabolites of DBT oxidation produced by these isolates have been identified and are similar to those reported in the literature. Bench-scale biodesulfurization studies carried out with Pseudomonas on conventional crude oil, heavy crude oil, and coker gas oil showed that microbes can remove sulfur compounds from various types of petroleum. Genetic analysis of some potential desulfurization biocatalysts is in progress with the intent to improve these strains by genetic engineering. Alternative processes and suggestions for future research are discussed. 29 refs., 8 figs.

37984 (AOSTRA–1988, pp. 12) **Improved dehydration techniques for heavy and extraheavy crudes.** Paz, H. (Petroleos de Venezuela, SA, Caracas, Venezuela); Loreta, A.; Figueredo, C. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

This paper addresses the design and operation logistics associated with the installation of pertinent dehydration facilities in the Hamaca Area of the Orinoco Heavy Oil Field in Venezuela. The operational infrastructure was programmed for handling of medium term production potential, in which an analysis of the best gathering, dehydration and crude oil storage scheme was required. Specific considerations were given to a centralized facility in which all dehydration is performed in a single area with the require infrastructure, versus a decentralized installation where facilities are distributed throughout the producing areas as required. These considerations were tested through conceptual engineering studies. As a result, the most attractive alternative, both economically and technically, was the centralized dehydration system. A subsequent study followed in order to develop the basic and detailed engineering for the centralized dehydration facility. In addition, specific dehydration processes considering wash tanks and electrostatic dehydrators were evaluated. On this basis, the centralized dehydration facility was designed to handle the medium term crude oil potential, diluent, and water associated with the production for the development of the North Hamaca Area. 3 refs., 5 figs., 4 tabs.

37985 (CHOA–8805) **Options for upgrading in western Canada. Proceedings [of the] quarterly meeting of the Canadian Heavy Oil Association.** Canadian Heavy Oil Association (Canada). 1988. vp. (CONF-8805308–: Quarterly meeting of the Canadian Heavy Oil Association, Calgary, Canada, 10 May 1988;CE–02644). Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $N/C.

This report contains papers which discuss processes and technology for upgrading heavy hydrocarbons. It includes a discussion of economic implications of upgrading, options, and alternative technologies for upgrading at the production site. Processes described include the thermal treatment of oil sand with the Taciuk process, the application of the H-Oil process to upgrading vacuum residuum, VGBA-COMBI cracking of bitumens, and the application of the CANMET hydrocracking process to vacuum tower bottoms. Separate abstracts have been prepared for six papers.

37986 (CHOA–8805, pp. 17) **Upgrading heavy crudes by using vaccum bottoms recycle in the H-Oil Process.** Wisdom, L. (HRI, Inc., Lawrenceville, NJ, USA); Tasker, K.G.; Colyar, J.J. Canadian Heavy Oil Association (Canada). 1988. (CONF-8805308–: Quarterly meeting of the Canadian Heavy Oil Association, Calgary, Canada, 10 May 1988;CE–02644). In *Options for upgrading in western Canada. Proceedings [of the] quarterly meeting of the Canadian Heavy Oil Association.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $N/C.

A test of heavy oil technology in upgrading Cold Lake vacuum residuum is reported. Commercial H-Oil Process operations with vacuum bottom recycle have demonstrated improved operation at moderate conversion levels, and better reactor temperature control, and have raised the operability limits for the operation at higher conversion levels. The 41-day Process Development Unit program conducted for Alberta Oil Sands Technology Research Authority clearly demonstrated the technical viability of high conversion heavy oil technology for the western Canadian market and provides a sufficient data base for the design and guarantee of an heavy oil unit to proccess Cold Lake feedstock. 9 figs., 9 tabs.

37987 (CHOA–8805, pp. 47) **VEBA-COMBI-Cracking. A proven technology for upgrading of Alberta heavy oils.** Wenzel, F.W. (VEBA OEL AG). Canadian Heavy Oil Association (Canada). 1988. (CONF-8805308–: Quarterly meeting of the Canadian Heavy Oil Association, Calgary, Canada, 10 May 1988;CE–02644). In *Options for upgrading in western Canada. Proceedings [of the] quarterly meeting of the Canadian Heavy Oil Association.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $N/C.

The paper gives a brief introduction into VEBA-COMBI-Cracking (VCC) technology, its merits with respect to achievable conversion rates, syncrude qualities, process flexibility and the usage of the remaining hydrogenation residue. Particular attention is addressed to economic and environmental considerations. It reports on specific experience with the two major heavy crudes from Alberta, Cold Lake bitumen and Athabasca bitumen, using results most recently generated by test programs in a VCC 200 bbl/d Pilot Plant. The actual commercial status based on past commercial experience, and process improvements on the Process Development Unit and pilot plant scale and confirmed in a semi-commercial plant (3 500 bbl/d), are is illustrated. 23 figs., 4 tabs.

37988 (CHOA–8805, pp. 30) **CANMET hydrocracking process demonstration plant - operating experience.** Muir, G. (Partec Lavalin, Inc., Calgary, AB, Canada); Denis, J.; Pruden, B. Canadian Heavy Oil Association (Canada). 1988. (CONF-8805308–: Quarterly meeting of the Canadian Heavy Oil Association, Calgary, Canada, 10 May 1988;CE–02644). In *Options for upgrading in western Canada. Proceedings [of the] quarterly meeting of the Canadian Heavy Oil Association.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $N/C.

The report summarizes the operation of the CANMET Hydrocracking Demonstration Unit in the cracking of vacuum tower bottoms in the Petro Canada Montreal Refinery. The design of the original system plus changes implemented during the program are discussed. The unit achieved a performance in which operations were predictable and straightforward. Upsets due to external factors resulted in a smooth reaction response with ample time for process adjustment. Conversion rates of up to 86 wt % were achieved. 6 refs., 9 figs., 4 tabs.

37989 (CHOA–8805, pp. 19) **Small field upgraders.** McCann, T.J. (RTM Engineering Ltd.). Canadian Heavy Oil Association (Canada). 1988. (CONF-8805308–: Quarterly meeting of the Canadian Heavy Oil Association, Calgary, Canada, 10 May 1988;CE–02644). In *Options for upgrading in western Canada. Proceedings [of the] quarterly meeting of the Canadian Heavy Oil Association.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $N/C.

This report discusses the process technology and economics currently available for upgrading heavy crudes and bitumens in the field. Two carbon rejection routes developed by Englehard and Toyo Engineering are discussed. These processes feature an increased yield of liquid product, a more easily hydrotreated product and reduced pitch in comparison with other carbon rejection processes. The third process uses hydrogen addition to produce a synthetic diluent which is subsequently blended with the heavy crude for transportation to a refinery by pipeline. 4 figs. 3 tabs.

37990 (DGMK–354) **Fundamentals of the simultaneous hydrodemetallization and hydrodesulfurization of heavy oils.** Weitkamp, J. Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.); Karlsruhe Univ. (T.H.) (Germany, F.R.). Engler-Bunte-Institut; Oldenburg Univ. (Germany, F.R.). Fachbegiet Technische Chemie. Aug 1988. 159p. (In German). Available from Copy held by UB/TIB Hannover.

This work is dealing with model studies on catalytic hydrometallization and hydrodesulfurization of heavy oils and residua. The catalytic hydrodemetallization was investigated in the presence of a sulfur component which is typical for petroleum. Model oils consisting of decalin, a nickel porphyrin and dibenzothiophene were employed. The investigations were carried out in a flow-tpye high pressure unit with a fixed bed reactor on a sulfided $CoO-MoO_3/Al_2O_3$ hydrotreating catalyst. For analysis of the liquid product samples, which were sluiced out periodically in short intervals, atomic absorption spectroscopy, UV/VIS-spectroscopy, capillary gas chromatography and high pressure liquid chromatography were used. The degree of conversion for both reactions and the product distributions as a function of time on stream were thoroughly investigated. This enabled new insights into the mutual influences of hydrometallization and hydrodesulfurization. (orig.) With 108 figs., 11 tabs., 174 refs.

0205 Products and By-products

37991 (AD-A–205155/5/XAB) **Fuel Stability Foam.** Power, A.J.; Arfelli, W.; Solly, R.K. Materials Research Labs., Ascot Vale (Australia). Aug 1988. 57p. (MRL-R–1132). Available from NTIS, PC A04/MF A01.

A new means of increasing the chemical stability of petroleum fuel during storage has been developed. Distillate fuel blends have been shown to form significantly less total particulate matter (comprising the sum of the suspended insoluble and adhered particulate matter) following storage in contact with Fuel Stability Foam (FSF) than similar reference fuels aged in the absence of FSF. The most-effective FSF material has been found to be a reticulated polyurethane which maximizes the fuel-stabilizing properties. This effect is at least equivalent to that of any known fuel-soluble chemical-stabilization additive. Enhanced filterability and decreased coloration of fuels after storage in contact with FSF were also observed. Total insolubles in aged fuels containing known deposit-promoting agents, including carboxylic acids, soluble copper and aromatic thiols, were reduced to low levels by the presence of FSF. Contributing mechanisms for the stabilizing action of FSF include adsorption by the FSF of chemical precursors to the particulate matter, absorption of soluble particulate matter, solution of solid particulate matter in the foam and adsorption and interaction with species to modify the acid/base environment of the fuel.

37992 (AOSTRA–1988, pp. 9) **Heavy oil coke utilization in the aluminum industry.** Calderon, J.L. (Alusuisse, ZH, Switzerland); Rodriguez, D.; Gomez, P.C.; Rodriguez, B.J.; Mannweiler, U.; Smith-Hatting, W.; Maitland, A. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

One widely proven commercial upgrading process for heavy oil is delayed coking which produces petroleum coke as a by-product. Due to physicochemical characteristics of heavy oil coke, its uses by the aluminum industry has been restricted. A broad investigation has been carried out on the production, characteristics and impact of the use of a heavy oil coke (Cerro Negro coke from Venezuela) in the aluminum industry. This research covers laboratory and field work on coke and anode quality, metals economic impact on commercial aluminum production cells. This paper presents some of the results obtained in this research program, which demonstrates that Cerro Negro coke can be used in anode manufacturing for aluminum cells. A beneficial effect has also been found of the presence of vanadium (500 ppM) on some aluminum alloys, a fact which makes it conceivable to view the vanadium impurity in the aluminum produced with Cerro Negro coke as an asset rather than a detriment which is the present assumption. 13 refs., 2 figs., 5 tabs.

37993 (AOSTRA–1988, pp. 20) **Utilization of HSC-ROSE residue as coking aid for production of high quality coke from lignite.** Bohlman, D. (VEB Petrolchemisches Kombinat? Schwedt); Limmer, H.; Schwedt, K.; Nandorf, W.; Hood, R.L.; Washimi, K. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

The The HSC-ROSE process is one of the latest heavy oil upgrading process by an optimum combination of thermal cracking and solvent deasphalting of the cracker residue. The HSC-ROSE residue is mostly used as boiler fuel. In order to improve the overall economy of upgrading, a study was conducted on the utilization of this residue as a coking aid for production of high quality cokes from lignite and other low grade materials by the BHT coking process. Results of laboratory and pilot plant tests indicated that by addition of 10 to 16 wt% HSC-ROSE asphaltene, high strength cokes comparable to blast-furnace coke could be produced from well-carbonizable lignites, and that high quality cokes could also be produced even from peat, bagasse and wood waste. In the course of coking with the HSC-ROSE asphaltene, additional volatile hydrocarbons are liberated which can be further upgraded to valuable products. The result of an economic evaluation on the BHT coke production from 2 million tons/y lignite using 10% HSC-ROSE asphaltene as coking agent indicated that a large scale application of this technology in the existing BHT coker should be feasible. 4 refs., 4 figs., 10 tabs.

0207 Marketing and Economics

Refer also to citation(s) 38006, 38048, 38512, 38518, 38639

37994 (CANWEC–1989 vp) **The outlook for Canadian demand for western Canada conventional light/medium crudes.** Mayo, R.J. (Petro-Canada Products). Canadian National Committee, World Energy Conference, Ottawa, ON (Canada). [1989]. (CONF-8811238–: 11. Canadian national energy forum, Calgary, Canada, 21-22 Nov 1988;CE–02686). In *Energy in Canada. The potential, the markets and the money.* Available from Canadian National

Committee World Energy Conference, Suite 305, 130 Albert Street, Ottawa, Ont., Canada K1P 5G4; $30.00 CAN.

From 1988–2005, the supply of conventional light Canadian crude is forecasted to decline, although the slack may be taken up by increased production of synthetic crudes from upgraders and bitumen heavy oil, with frontier crudes expected to come on in significant volumes in post-1996. Current domestic consumption of synthetic crude oil falls below the maximum potential that could be achieved with refinery equipment in place and it is unlikely that demand will equal supply with the current quality offered and under the pricing now in place. There are also limitations to the refiner in running heavy oil, since the ability to process heavy oil is limited by the ability to sell the large columes of residual components associated with the product. The paper addresses supply and demand for both these products, and the measures needed to increase their market share, concluding that there is an opportunity to increase the use of synthetic crudes, but that will be dependent on the pricing and quality of the crude. Therefore, significant exports of heavy oil will be required in the long-term if production reaches the forecast levels.

37995 (CANWEC–1989, pp. 89-92) **United States demand for Canadian heavy crudes.** Montgomery, W.J. (Amoco Corp., Chicago, IL, USA). Canadian National Committee, World Energy Conference, Ottawa, ON (Canada). [1989]. (CONF-8811238–: 11. Canadian national energy forum, Calgary, Canada, 21-22 Nov 1988;CE–02686). In *Energy in Canada. The potential, the markets and the money.* Available from Canadian National Committee World Energy Conference, Suite 305, 130 Albert Street, Ottawa, ON, Canada K1P 5G4; $30.00 CAN.

Amoco has had operations in Canada for 40 years and today, with the acquisition of Dome Petroleum, it is one of the largest Canadian producers. This report describes the U.S. market and its growing need for greater quantities of imported crude oil, how Canadian supply fits into the total refinery picture, how Canadian exports have already captured an impressive share of the United States market, and how that share can be increased. New marketing opportunities for Canadian crudes are identified, although there are transportation problems, refinery limitations and potential netback reduction. 4 figs.

37996 (CHOA–8812, pp. 17) **Canadian Heavy crude oil. supply/demand, 1988-2000.** Mink, F.J. (Alberta Energy Resources Conservation Board). Canadian Heavy Oil Association (Canada). 1988. (CONF-881295–: Conference on heavy oil markets in the 90s: how do they look?, Calgary, Canada, 1 Dec 1988;CE–02646). In *Heavy oil markets in the 90s. How do they look?.* Available from Canada Oil and Gas Lands Administration, 355 River Rd., 15th Floor, Tower B, Ottawa, ON, Canada K1A 0E4; $N/C.

The heavy crude oil industry in Canada has a resource base that offers a significant potential for growth within measureable technological risks. However, high operating costs, uncertainty of crude prices, pipeline constraints to markets, limited diluen t supply and finite market opportunities all make it vulnerable to a higher business risk, possibly preventing a rapid expansion in the foreseeable future. This paper provides an overview of some of the supply/demand senarios for Canada, as developed by the Alberta Energy Resources Conservation Board, the implication s the industry must resolve before their occurrence. 7 figs.

37997 (CHOA–8812, pp. 17) **Non-traditional markets.** Doyle, T.D. (Trans Mountain Pipe Line Co. Ltd.). Canadian Heavy Oil Association (Canada). 1988. (CONF-881295–: Conference on heavy oil markets in the 90s: how do they look?, Calgary, Canada, 1 Dec 1988;CE–02646). In *Heavy oil markets in the 90s. How do they look?.* Available from Canada Oil and Gas Lands Administration, 355 River Rd., 15th Floor, Tower B, Ottawa, ON, Canada K1A 0E4; $N/C.

According to the forecasts, conventional Canadian heavy oil production will decline and raw bitumen production will increase from the present to 2000. While the traditional markets in the Northern Tier and Midwest areas of the United States are becoming saturated, the demand has increased on the United States Gulf coast and in the western portion of the Pacific Rim, including Korea, Japan and other centres in southeast Asia. This paper concentrates on those West Coast ad Pacific Rim markets and describes Trans Mountain Pipe Line Company Ltd.'s application to the National Energy Board for the expansion of current pipeline capacity between Edmonton and Vancouver, and their plans for further construction. 11 figs.

37998 (CHOA–8812, pp. 13) **Traditional markets.** Daniel, P.D. (Interprovincial Pipe Line Co.). Canadian Heavy Oil Association (Canada). 1988. (CONF-881295–: Conference on heavy oil markets in the 90s: how do they look?, Calgary, Canada, 1 Dec 1988;CE–02646). In *Heavy oil markets in the 90s. How do they look?.* Available from Canada Oil and Gas Lands Administration, 355 River Rd., 15th Floor, Tower B, Ottawa, ON, Canada K1A 0E4; $N/C.

The objective of this paper is to provide an overview of the traditional markets for Western Canadian heavy crude oil. Today's markets are defined and their development and expansion over the past few years is outlined. From that background, the potential for future growth in those traditional markets is discussed. With this analysis of future market potential in place, the existing transportation network is described. Due to the current relevance of limitations in pipeline capacity to those traditional markets, a summary of those limitations and potential expansion plans is presented. Current forecasts would indicate that insufficient capacity exists in the current west-to-east oil pipeline system to move the expected Western Canadian production. Matching those production forecasts are market analyses that call for expanded demand, particularly in the U.S. midwest. The objective of the transportation system is to continue to match those needs of supply and market and provide the best possible netback to the producer. 7 figs.

37999 (DOE/EIA–0508) **Determinants of profitability differences among major refiner/marketers.** USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Markets and End Use. [1985]. 10p. Sponsored by DOE Management & Administration. Order Number DE89015002/JAW. Available from NTIS, PC A03/MF A01 - GPO - OSTI; GPO Dep.

This report attempts to shed light on the factors affecting the differing profitabilities among companies, particularly, the effect of refinery upgrading, to contribute toward a better understanding of the performance of the domestic petroleum refining industry. The determinants of domestic refining-marketing profitability in the short run are evaluated. The focus is on those factors affecting the profitability of operations using the existing capital stock. Of particular interest is the effect on profitability of investments made for refinery upgrading. The refining-marketing segment is assumed to be operated to maximize profits of that segment rather than the profits of some other segment. The cost and financial data used in the analysis are proprietary line-of-business data from the FRS. The FRS provides detailed information on refining-marketing revenue, cost, income, and investment. The specific data used are discussed and key definitions provided later in this report. 14 refs., 1 fig., 2 tabs.

38000 (GAO/NSIAD–87-159BR) **International Energy Agency.** General Accounting Office, Washington, DC (USA). National Security and International Affairs Div. 1988. 77p. Available from US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The possibility of a serious oil supply disruption led to creation of the International Energy Agency by the major oil consuming nations. One of IEA's objectives is to reduce the consequences of serious supply disruptions by sharing shortfalls. This report reviews U.S. participation in the most recent test of IEA's emergency oil sharing system. It examines how the test was designed and how well its objectives were met; it assesses U.S. participation and performance; and it evaluates the extent to which the oil sharing system and U.S. participation in it meaningfully exercised U.S. energy emergency preparedness plans and provided useful training.

38001 (GAO/RCED–87-98) **Mineral resources.** General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. 1988. 18p. Available from General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

Federal regulations require that onshore oil and gas leases that are subsequently determined to overlie a known geologic structure are to have their rental rates increased. The Bureau of Land Management does not have internal controls that ensure that such rental increases are processed consistently and in a timely manner. Although BLM's state offices in Colorado and Wyoming generally

increased rental rates for leases determined to overlie known geologic structures, these increases were not made in a timely manner during calendar years 1984 and 1985. These delays resulted in lost revenue of $552,614. There were also a few instances in the two states in which the rental rates had not been increased at all, causing an additional revenue loss of at least $15,123.

38002 (ORNL/FTR–3316) **[Energy modeling of world oil market, Laxenburg, Austria, June 19–23, 1989]: Foreign trip report.** Leiby, P.N. Oak Ridge National Lab., TN (USA). 27 Jun 1989. 23p. Sponsored by DOE Fossil Energy. DOE Contract AC05-84OR21400. Order Number DE89013140/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An understanding of the oil market bears directly on DOE research conducted by ORNL on strategic petroleum reserve planning and global climate change. The workshop discussions highlighted the principal factors underlying the current consensus energy forecast: an expectation of increased energy conservation (particularly of oil) in the face of low oil prices; and an expectation of an increase in the supply on non-OPEC oil. Crucial questions to be examined in further meetings include whether we really believe such nonprice conservation will occur, and what factors may cause energy demand to grow more slowly than GDP, even for low or constant energy prices. It was also noted that the role of conservation may be very different in developing countries than developed ones. In the area of energy-climate change assessment, some substantial new efforts were reported. Analyses indicate the costs of CO_2 emissions reduction are very high, in the absence of new technology. Two new models for examining the value of new technologies were presented. In addition, one of the first attempts to quantitatively evaluate both the costs and benefits of greenhouse gas emission limits was described.

0208 Waste Management

Refer also to citation(s) 37978

38003 (AOSTRA–1988, pp. 20) **Process options for recycle of TDS produced water during in-situ recovery of heavy oil.** Zaidi, A. (Environment Canada, Burlington, ON, Canada); Kok, S.; Schmidt, J.W. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

Produced waters containing total dissolved solids (TDS) concentrations substantially above 8 000 mg/l cannot be recycled for steam generation in conventional once-through steam generators unless they are treated to remove TDS. Major technologies for removing TDS from produced waters are evaporation, membrane processes (reverse osmosis and electrodialysis), and freeze desalination. Among the evaporation processes, vapor compression evaporation has been field tested on pilot scale for removing TDS from produced water at an in-situ heavy oil recovery site in Alberta. Membrane processes have been tested in bench scale tests on produced water samples from Canadian heavy oil fields. One of the freeze desalination processes, desublimation vacuum freezing, is currently under development in the USA, and bench scale trials on oilfield brines are being conducted. Vapor compression evaporation is technically considered the most developed process. Electrodialysis is available for field testing, while freeze desalination requires additional developmental work before it can be applied in the field. For a produced water treatment plant producing 3 000 m^3/d of once-through oilfield steam generator feed in Canada, the cost of TDS removal per cubic meter of steam generator feed is estimated to be $1.33 for freeze desalination, $1.66 for electrodialysis, and $2.07 for vapor compression evaporation. These costs include capital depreciation, based on a plant life of ten years. 11 refs., 14 figs., 8 tabs.

38004 (AOSTRA–1988, pp. 8) **Steam generation using high TDS water and heavy fuels.** Thielen, W. (Steinmuller, Germany); Waldmann, H.; Moricet, M.; Padron, A.; Camacho, F. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

The use of produced water with high total dissolved solids as boiler feedwater for steam generation in heavy oil operations has been demonstrated. In addition, the technical feasibility of burning heavy fuels with high vanadium and sulfur contents has been shown in pilot-scale tests. A suspension burner, capable of firing heavy crude, vacuum residue and petroleum coke, was tested in combustion experiments that also included tests on flue gas desulfurization. Results indicated flame stabilization is possible without supporting fuel, satisfactory burnout rates and emission levels were obtained, and use of the wet flue gas desulfurization technique yields dewatered gypsum as the final product. In steam generation tests, an economically acceptable water treatment system was developed to use actual production water from Venezuelan fields. Flocculation was used to remove emulsified oil, and the combination of hot line precipitation and ion exchange was suitable for hardness removal. Total dissolved solids up to 25,000 ppM could be handled in the steam generator evaporator tubes. A mobile steam generation unit with water treatment plant was designed and field-tested, and results to date indicate that usage of production water for steam generation in combination with combustion of heavy fuels is possible. 8 figs., 1 tab.

38005 (AOSTRA–8808, pp. 18) **HDH, a process for residue conversion.** Marzin, R. (INTEVEP, S.A., Caracas, Venezuela); Guitian, J.; Krasuk, J.; Silva, F.; Souto, A.; Solari, B. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

In 1985, the HDH process was presented as a new technology for the upgrading of heavy oils from the Orinoco Oil Belt in Venezuela. During the last three years, this process has been successfully scaled up from bench scale to a 1 ton/h pilot plant; the data collected have confirmed the technical information obtained previously at bench scale. The HDH process is now being extended in its application to convert residues of petroleum refineries, according to the trends of the oil market. The process itself is described. The results from the 1 ton/h pilot plant are discussed, in particular the effects of the feedstock and the regeneration and disposal of the catalyst, a cheap mineral from Venezuela. Residue conversion at 510^0C in the recycle mode of operation is greater than 95%. The development of the HDH process has been carried out, up to now, in three pilot plants of different scales; in July 1987, a joint engineering study was started to design a commercial prototype plant. 6 refs., 10 figs., 7 tabs.

0210 Legislation and Regulation

38006 (DOE/EIA–0266) **Expiration of the Emergency Petroleum Allocation Act: Impact on EIA's data collection activities.** USDOE Energy Information Administration, Washington, DC (USA). 30 Dec 1980. 142p. Sponsored by DOE Management & Administration. Order Number DE89014981/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

This study was undertaken by the Energy Information Administration (EIA) to investigate and make recommendations concerning the impact of the expiration of the Emergency Petroleum Allocation Act of 1973 (EPAA), as amended, on EIA's data collection activities. EIA intends to take immediate action on these recommendations in order to avoid data lapses, patchwork data collection and potential respondent confusion. The prospect of early decontrol adds further urgency to the need for action on the recommendations. Summarized below are the principal assumptions, findings and recommendations, and impact of the study.

0220 Transport, Pipelines, and Handling

Refer also to citation(s) 37997, 37998

38007 (AOSTRA–1988, pp. 14) **Core-annular flow. The most economical method for the transportation of viscous hydrocarbons.** Guevara, E. (Petroleos de Venezuela, S.A.); Zagustin, K.; Zubillaga, V.; Trallero, J.L. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

A study is being carried out to investigate the possibility of transporting viscous hydrocarbons through pipeline using the core-annular flow mode of operation. In this mode of transportation a less viscous immiscible fluid such as water is introduced into the flow to act as a lubricating layer for absorbing the shear stress existing between the walls of the pipe and the fluid, thereby keeping a low pressure loss. A set of experiments is reviewed, the aim of which is to further confirm the practical feasibility of stable core flow for extremely viscous hydrocarbons (up to 110,000 centipoises). Promising results have been obtained in a 203 mm x 1000 m facility where several steady state tests had been performed by changing the water fraction and the oil flow rate. The viscosity was varied by changing the oil type. An operational procedure was developed for the restart of the systems after a long period of standstill and a theoretical model to predict the pressure drop has also been developed. 7 refs., 11 figs.

38008 (AOSTRA–1988, pp. 12) **Field trials of TRANSOIL technology for emulsion pipelining of bitumen.** Hardy, W.A. (BP Resources Canada Ltd., Calgary, AB, Canada); Sit, S.P.; Stockwell, A. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

Field trials were conducted using the patented TRANSOIL emulsion technology to produce bitumen-in-water emulsions for pipeline transportation purposes. The field trials were conducted at the Wolf Lake Project in Alberta during the summer/fall 1987 and the winter of 1988. The objectives of the field trials included: production of the emulsion at 500 bbl/d, the maximum plant design flowrate; evaluation of the storage stability of the emulsion; pipeline transportation of the emulsion between two batches of sales-specification bitumen blend; restarting the pipeline filled with emulsion; resolving the emulsion using a standard heater/treater unit; and conducting some of the above objectives under winter weather conditions. All objectives were successfully met within the parameters of time, flow and emulsion quality that were set out by the TRANSOIL group for the field trials. This paper includes a short discussion of the TRANSOIL emulsion technology, a description of the surface facilities at the Wolf Lake Project and the La Corey Pipeline station, and plans for future field trials for the emulsion pipelining technology. 8 figs.

38009 (AOSTRA–1988, pp. 15) **Imulsion technology, the answer for the production, handling, and transportation of extra heavy crudes and bitumens.** Layrisse, I. (INTEVEP, S.A., Caracas, Venezuela); Rivas, H.; Quintero, L.; Rivero, M.; Martinez, A. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

The production and handling of very viscous hydrocarbons involves the use of high-cost methods, such as heating and diluting. Among the major disadvantages involved with these techniques are the energy consumption for heating and the light-for-medium crudes trade-off associated with dilution. A remedy for this seemingly unattractive situation can be the production and handling of such highly viscous hydrocarbons in the form of emulsions. In emulsions, the extra heavy crude or bitumen is suspended in the water (the external phase) in the form of micro spheres, thus achieving a reduction of viscosity. A many-faceted Venezuelan research program was started at the laboratory level, in order to study the feasibility of producing and handling extra heavy crudes or bitumens with emulsion technology. Experimental studies permitted the development of various additive packages, emulsion formation techniques, and emulsion breaking schemes, and a fluid mechanics evaluation of the pipeline transport of emulsified hydrocarbons. To validate the results at the industrial level, field tests were also conducted, using the techniques called Imulsion Technology. The most relevant results of these research programs are reviewed. Once the field tests proved the feasibility of the Imulsion Technology, existing facilities were adapted in order to produce and handle a considerable volume of emulsion (15,000 bbl/d). The results showed that the artificial lifting of heavy and extra heavy crude oils as a bitumen-in-water emulsion improves the production process. Furthermore, degasification and transportation of an emulsion are much easier and cost effective than conventional procedures. Finally, the emulsion proved to be sufficiently stable during the ocean transportation test. 18 refs., 17 figs., 5 tabs.

38010 (AOSTRA–1988, pp. 19) **Heavy crude transportation.** Thelen, H.-J. (VEBA OEL Entwicklungs Gmbh, Gelsenkirchen, Germany); Briceno, G. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

A study has been performed to show the optimum concept of a transportation system for heavy crude including tanker transportation, port handling and storage facilities. Focusing on hot transportation, appropriate solutions also had to be found for land transportation in order to consider a complete chain from the production field to a European refinery. The transportation system is described mathematically and optimized considering the main parameters for a given throughput, such as number of tankers/tanker size, travelling speed, loading/discharge rates, and crude temperature. Thus a design basis could be laid for a large size tanker capable to transport heavy crude at elevated temperatures as well as for handling and storage ashore. For pipeline transport, two systems were considered: hot transportation for newly installed lines, and cold transportation of a diluent blend for existing pipelines. Therefore, problems of high viscosity pumping as well as mixing, cooling and safety had to be solved. The design solutions found for all steps of the system comply with the goal of maximum transport economy (minimum transport costs). 11 figs., 6 tabs.

0230 Properties

Refer also to citation(s) 37842, 37869, 37918, 37942, 38048, 38078, 38080, 38081, 38909, 38912

38011 (AOSTRA–1988, pp. 9) **Techniques and applications of PVT analysis of heavy crude oils.** Nair, P.C. (Petroleum Testing Services, Inc.); Wendel, D.J. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

In the pressure-volume-temperature (PVT) analysis of heavy oils, many problems arise as a result of their high viscosity and density. The PVT tests routinely applied to heavy oils are described, and the problems of oil-water separation, mercury fingering and oil-gas separation, as encountered in these tests, are discussed. Procedures are outlined for solving these problems. These techniques generally

result in much longer analysis times for the heavy crudes. Two examples are presented of specialized tests that can be designed to evaluate the potential of different enhanced oil recovery processes as applied to heavy oil reservoirs. The examples examine the lowering of oil viscosity by steam injection and by gas injection. 4 refs., 10 figs.

38012 (AOSTRA–1988, pp. 12) **Effects of diluents and carbon dioxide on asphaltene flocculation in heavy oil solutions.** Fuhr, B.J. (Alberta Research Council, AB, Canada); Klein, L.L.; Komishke, B.D.; Reichert, C.; Ridley, R.K. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

The relative strengths of diluents for heavy oils may be determined by comparing their ability to delay the onset of asphaltene flocculation when titrated with n-pentane or n-heptane. It was shown that the solvent strength of a blend of two condensates, at ambient temperature and pressure using n-pentane as titrant, is a linear function of the volume percentage of one of the condensates. Using this linear relationship, the strengths of condensate blends, which are potential diluents for the transportation of heavy oils, are easily predictable. A relatioship was also developed to enable the viscosity of a solution of heavy oil in any blend of two diluents to be predicted. Inputs are the viscosities of each pure diluent and that of one concentration of heavy oil in a known blend of the diluents. Preliminary data on the effect of carbon dioxide, which is being tested as an aid to the in situ recovery of heavy oil from oil sands, have been obtained. Heavy oil in toluene solutions at different CO_2 concentrations as titrated with n-heptane in a pressure vessel, at temperatures as high as 100^{0}C and pressures up to 700 psi. It was found that the higher the CO_2 concentration, the greater was the tendency for asphaltenes to flocculate as n-heptane was added. An increase in temperature from ambient to 100$_0$C decreased the tendency for flocculation. Beyond a certain concentration, CO_2 itself was sufficient to cause flocculation. 10 refs., 7 figs., 5 tabs.

38013 (AOSTRA–1988, pp. 13) **Rheological measurement of oil-in-water emulsions. Wall slip and its correction for concentric cylinder viscometer.** Zhang, J. (East China Petroleum Inst., Beijing, People's Republic of China); Yan, D. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

This paper concerns the rheological characterization of heavy oil-in-water emulsions with concentric cylinder viscometer, as part of a study on transporting heavy crude oils as an oil-in-water emulsion. Slippage might occur at the cylinder walls during measurement, and considerable deviation of the calculated viscosities from the real one might be incurred if the wall slip effect is neglected. The mechanism of the wall slip, its influencing factors, and its correction are discussed on the basis of rheological measurement for oil-in-water emulsions with heavy oil fraction from 0.5 to 0.8 and in a temperature range from 10 to 60^{0}C. Experimental and analytical results show that the viscosity deviation, i.e., the wall slip effect, depends not only on the oil fraction of the emulsions and temperature, but also on the relative size of the oil droplets to the gap between the cylinders. 12 refs., 6 figs., 3 tabs.

38014 (AOSTRA–1988, pp. 16) **Water treatment in heavy oil production.** Anselni, A. (Petroleos de Venezuela, Caracas, Venezuela); Cosme, S.; Lopez, F.; de Ojeda, M.; Morales, G.; Liendo, F.; Layrisse, I. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

The effectiveness of a series of ten commercial polyelectrolytes currently used in the Venezuelan oil industry for treatment of oilfield waters was evaluated, using model systems consisting of dispersions of two representative Venezuelan heavy (Tia Juana Heavy) and extra-heavy (Cerro Negro) crude oils. Preliminary screening tests (jar tests) reduced the number of the above additives to four, which were further studied in more detail by means of jar tests and electrokinetic measurements. The results obtained are consistent with a charge neutralization mechanism and flocculation rate determined by Brownian diffusion and velocity gradients. On the basis of structural information, some possible correlation between structure and efficiency is outlined. Also, apparent differences in activity of the more effective polyelectrolytes can be attributed to active ingredient content differences between the products studied. Further experimental work is in progress in order to extend this study to other Venezuelan heavy crude oil-water systems. 12 refs., 11 figs., 5 tabs.

38015 (AOSTRA–1988, pp. 22) **Pressurized differential scanning calorimetry studies of heavy oils and their relevance to in-situ combustion.** Belkharchouche, M. (Univ. of Salford, Salford, England); Hughes, R.; Price, D. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

A Du Pont pressurized differential scanning calorimeter has been used to obtain information on the magnitude and rate of the heat changes accompanying combustion of oil and oil core samples, which are a necessary prerequisite for assessing the feasibility of in-situ combustion. Samples tested included Marguerite oil and Wolf Lake cores, Athabasca oil sand and a North Sea core. The overall exothermicity of combustion was found to increase with increasing total pressure and with oxygen partial pressure up to 34% O_2. Above this concentration the exothermicity was essentially constant. Increasing the matrix surface area causes the low temperature oxidation to become predominant, while addition of clay to an oil/sand mixture causes both low and high temperature oxidation peaks to coalesce and also gives a very large increase in the exothermicity of the process. 15 refs., 13 figs., 5 tabs.

38016 (AOSTRA–1988, pp. 15) **Contribution of geochemical studies undertaken on Bemolanga tar sand deposit and Tsimiroro heavy oil field for hydrocarbon exploration in Madagascar.** Raveloson, E. (Office Militaire National pour les Industries Strategiques (OMNIS), Antananarivo, Madagascar); Rakotoarison, S.; Andriamanantena, J.; Ramarofidy, J.; Raharijaona, R.; Ramanampisoa, L. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

Bemolanga (BML) and Tsimiroro (TSM) are the two largest non-coventional hydrocarbon fields in Madagascar. Sandstone formations of the upper Triassic constitute the main reservoir rock. To understand origin of these oils, several geochemical studies have been undertaken on the BML and TSM deposits and on different formations of the Majunga and Morondava basins, in which these deposits are located. This paper presents the main results of those studies, and attempts to explain the contribution of these results to hydrcoarbon exploration in Madagascar. Data in this paper combine analyses carried out at various laboratories since the beginning of petroleum exploration by different companies. The geochemical studies concluded that the advanced biodegraded state of the BML and TSM oils in the Permo-Triassic has not allowed easy comparison with the same formation oil and that of the Jurassic formation.

Possible source rocks of the oils were exposed and have shown that the sakoa formation and some levels in Permo-Triassic and Jurassic formations may constitute potential source-rocks. However, the geodynamic structure of the basins, with high bottoms and depressions, does not allow a precise delineation of the possible source rock sequences. 15 refs., 7 figs., 6 tabs.

38017 (AOSTRA–1988, pp. 16) **Organic geochemistry of Venezuelan heavy and extra heavy crude oil.** Cassani, F. (INTEVEP, S.A., Caracas, Venezuela); Gallango, O. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

This work represents a regional geochemical study performed on Venezuelan heavy and extra heavy crude oils. These oils are mainly located in the Maracaibo and Eastern Venezuelan basins and originate from Cretaceous marine source rocks. A wide range of thermal maturity is established based on selected biological marker parameters. Some of the heavy and extra heavy oils are originated from early mature source rocks but most of them are the result of biodegradation after their accumulation in the presently shallow reservoirs. The extent of this alteration process is studied by distribution of biological markers. In such biodegraded oils, very little can be said about the origin, maturity and level of biodegradation without the examination of biological markers. In severely biodegraded oils, where most of the biomarkers have been altered by biodegradation, the analysis by gas chromatography/mass spectrometry of new biological markers released by pyrolysis of asphaltenes have been found necessary for the geochemical evaluation of these oils. New findings obtained from the effects of biodegradation studies support the theory that biodegradation conditions in the subsurface affect the distribution of biological markers differently than to that in the surface exposures. Mixed oils (extremely biodegraded with unbiodegraded) have been identified in different basins and their thermal maturity and level of biodegadation have been compared with their rheological properties. This information is important in the production of heavy and extra heavy oils especially in enhanced oil recovery. The implication of the geochemical characteristics on the production of Venezuelan heavy and extra heavy crude oils is discussed. 20 refs., 8 figs., 4 tabs.

38018 (AOSTRA–1988, pp. 12) **Geochemistry of heavy crudes of the Hamaca Area of the Orinoco Oil Belt, eastern Venezuela.** Flores, D.M. (CORDOVEN, S.A., Puerta La Cruz, Venezuela). Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

Recent geochemical studies in the A and B blocks of the Hamaca area of the Orinoco Oil Belt allow a better understanding of the characteristics of the heavy oils acumulated in the area. Both standard geochemical analysis and gas chromatography/mass spectrometry of the saturated and aromatic fractions were used to discern the areal and vertical distribution of the crudes. Inspissation and degradation were factors considered to explain decreasing oil gravities with depth in the fields analyzed. Biomarkers and formation water salinities were employed to explain biodegradation patterns. Migration, maturity and origin of the hydrocarbons were addressed through correlations with results or previous geochemical studies in the eastern Venezuela basin. It was concluded that the discrete vertical segregation of heavy oils observed in the A and B blocks is due to both vertical segregation and biodegradation differences between pooled reservoirs. Water washing may have been a very influential factor in the degradation of these oils. They show minor to moderate biodegradation levels according to Volkman's classification. Geochemical characteristics of these oils suggest a Cretaceous origin when compared to data of other eastern Venezuela oils; therefore, long distance migration is implied. Hamaca oils seem to be remnant segregation end products of type I and type III oils, specially the latter, generated farther to the north into the basin. 11 refs., 8 figs., 4 tabs.

38019 (AOSTRA–8808, pp. 10) **Modified shape factors for improved viscosity predictions using corresponding states.** Monnery, W.D. (Univ. of Calgary, Calgary, AB, Canada); Mehrotra, A.K.; Svrcek, W.Y. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

A modified version of the Ely-Hanley extended corresponding states viscosity model is presented. The shape factor correlations have modified and calculation of the reference fluid density has been simplified to improve predicted liquid viscosities of pure component hydrocarbons. The results of the modified method are compared with experimental data for 47 common hydrocarbons. The average deviation between the predicted and experimental viscosities for these compounds is within 2%. 23 refs., 1 fig., 6 tabs.

38020 (AOSTRA–8808, pp. 23) **Classification standard of heavy oil, screening criterion for steam thermal recovery and reserve classification.** Wanzhang, L. (RIPED, Beijing, China). Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

Steam stimulation technology has been commercially applied to 6 heavy oilfields in China up to now; several steam drive pilots are under operation or construction. Annual heavy oil production using by steam thermal recovery process reached 3 M ton in 1987. There are many different types of heavy oil reservoirs in China, with various petrophysical and geological characteristics. Considering the oil properties and the classification standards by UNITAR, this paper presents oil classification standards applicable to heavy oil, superheavy oil, or natural bitumen. It also describes the different types of heavy oil reservoirs in China and a screening criterion for steam thermal recovery. Present recovery technology, as well as proposed methods implementing short-term improvement and/or long-term development, were considered in the study of five groups of reservoirs. This paper also presents a quality classification standard for heavy oil reserves, which is needed for reservoir evaluation. 21 refs., 22 figs., 7 tabs.

38021 (CHOA–8709, pp. 17) **Field performance of a capacitance probe based welltest system.** Canadian Heavy Oil Association (Canada). 1987. (CONF-8709445–: 6. quarterly meeting of the Canadian Heavy Oil Association, Calgary, Canada, 22 Sep 1987;CE–02642). In *Surface facilities optimization program. Proceedings [of the] fifth quarterly meeting of the Canadian Heavy Oil Association.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $N/C.

Higher water/oil ratios and low separation rates in heavy oil production systems require a different design for welltest systems, compared to conventional petroleum applications. This paper describes a three-phase separator/capacitance probe system capable of providing accurate and reliable welltest data in a heavy oil project. A process vessel larger in size than a normal test separator was designed specifically to separate large amounts of water under difficult conditions. The capacitance probe functions by having the oil/water emulsion act as the dielectric of a capacitor, and takes advantage of the 40:1 ratio between the dielectric properties of the two phases. Associated circuits provide volume information relating to the flow stream, and resolve this information into discrete oil and water volumes. Field performance of the test system at the Suncor project is outlined. 5 figs., 2 tabs.

38022 (CHOA–8709, pp. 6) **Selection, application and performance of demulsifiers in heavy oil treatment.** Nixon, D. (Petrolite Canada, Inc., Calgary, AB, Canada). Canadian Heavy Oil Association (Canada). 1987. (CONF-8709445–: 6. quarterly meeting of the Canadian Heavy Oil Association, Calgary, Canada, 22 Sep 1987;CE–02642). In *Surface facilities optimization program. Proceedings [of the] fifth quarterly meeting of the Canadian Heavy Oil Association.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $N/C.

Due to the chemistry and contaminants in heavy oil emulsions, demulsification is not as simple a process as it is with light and medium crudes. This paper discusses the characteristics of heavy oil emulsions, their formation, stability, and breakup, starting with basic emulsion theory. Stability of heavy crude emulsions can be very high because of the high crude viscosity, extremely small droplet size if the emulsion is produced via fireflood or steamflood processes, and solids content. The total emulsion system, with all the interrelationships between various components, has to be taken into account when designing a method for heavy oil demulsification. 4 refs., 1 tab.

38023 (DGMK–405) **Volumetric shrinkage resulting from blending crude oils.** Rahimian, I. Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.); Institut fuer Erdoelforschung, Clausthal-Zellerfeld (Germany, F.R.). Dec 1988. 76p. (In German). Available from Copy held by UB/TIB Hannover.

Volumetric shrinkage occurs when different crudes/mineral oils are being blended. This volumetric shrinkage has been defined by density measurement and weighing of oil as well as of the oil mixtures. Relative volumetric shrinkages up to 0,56 vol. percent were observed. With increasing density ratio respectively bigger density difference of the components to be blended the volumetric shrinkage increases; until now a generally valid correlation could not be derived. (orig.) With 41 figs., 45 tabs., 23 refs.

0240 Storage

Refer also to citation(s) 37939, 37991

03 NATURAL GAS

0302 Geology and Exploration

Refer also to citation(s) 39102

0303 Drilling, Production, and Processing

Refer also to citation(s) 37982

38024 (CEA-CONF–9772) **Development of gaseous permeation membranes adapted to the purification of hydrocarbons.** Lecomte, C.; Deschamps, A.; Dick, R. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie. 1988. 14p. (CONF-881260–: Conference on future industrial prospects of membrane processes, Bruxelles, Belgium, 6-7 Dec 1988). Order Number DE89781452/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The objective is to develop gaseous permeation membranes adapted to natural gas dehydration and sweetening, especially for offshore application. Characteristics of membranes adapted to this application are discussed through chemical engineering and economic evaluation studies. A specific polymer belonging to the aromatic polyimides family has been selected for the manufacture of membranes, meeting the requirements of the objective. Hollow fibers have been produced and tested in form of minimodules of a few hundred of fibers. The results obtained on pure gases and simulated natural gas are discussed.

38025 (DGMK–167-5) **Proppant stability under reservoir conditions upon stimulation of deep tight gas reservoirs. Final report. Pt. 2. Stimulation of low permeable deep gas reservoirs (phase III).** Heide, H.; Eisenblaetter, J.; Joest, H.; Albertsen, M. Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.); Battelle-Institut e.V., Frankfurt am Main (Germany, F.R.). Sep 1988. 35p. (In German). Contract BMFT 03E-3068-B. Available from Copy held by UB/TIB Hannover.

Proppants are needed in hydraulic fracturing of tight gas reservoirs to hold the frac open and to maintain satisfactory permeability during the lifetime of the reservoir. Under the extreme pT conditions of deep gas reservoirs, high mechanical and chemical stability of the proppants is required. This report outlines the methods and results of an experimental research programme concerning the stability of proppants. It is shown that rock mechanics and chemical processes are interacting in the process of proppant disintegration. The resulting reduction of permeability is attributed partly to the plugging effect of mobilised fines and partly to precipitation of dissolved proppant constituents in the form of gels. Inclusion of bed rock into the long-time investigations which had so far been performed only between steel plates resulted in a marked shift of the dissolution and precipitation phenomena shown by the examined proppant packings; this relativised the initially found comparatively high chemical stability of the ZrO_2 proppant compared with that of the Al_2O_3 proppant and made the final quantitative evaluation of the two types of proppants rather difficult. The results are discussed on the basis of wet-chemical, electronmicroscopic, radiographic and particle-geometric analyses. They produce evidence for the great importance of integrating all the physical and chemical conditions in such model investigations. (orig.) With 17 figs., 5 tabs.

0306 Marketing and Economics

Refer also to citation(s) 38001, 38639

38026 (CANWEC–1989, pp. 35-38) **The changing natural gas industry and the role of New York Mercantile Exchange natural gas futures.** McFadden, R.T. (New York Mercantile Exchange). Canadian National Committee, World Energy Conference, Ottawa, ON (Canada). [1989]. (CONF-8811238–: 11. Canadian national energy forum, Calgary, Canada, 21-22 Nov 1988;CE–02686). In *Energy in Canada. The potential, the markets and the money.* Available from Canadian National Committee World Energy Conference, Suite 305, 130 Albert Street, Ottawa, Ont., Canada K1P 5G4; $30.00 CAN.

In the United States, increasing deregulation of the natural gas industry has led to an increase in selling on the spot market at short-term market-sensitive prices. The increased deregulation in Canada is likely to lead to the same result. The New York Mercantile Exchange (NYMEX) is involved in the oil futures market and wishes to establish a natural gas futures market. This paper gives a short description of the regulatory steps involved and the service NYMEX would offer to the natural gas industry, such as price discovery, risk management, and investment opportunity.

38027 (CANWEC–1989, pp. 46-48) **Perspectives of a major United States gas distributor.** Matthews, C.G. (Brooklyn Union Gas Co., USA). Canadian National Committee, World Energy Conference, Ottawa, ON (Canada). [1989]. (CONF-8811238–: 11. Canadian national energy forum, Calgary, Canada, 21-22 Nov 1988;CE–02686). In *Energy in Canada. The potential, the markets and the money.* Available from Canadian National Committee World Energy Conference, Suite 305, 130 Albert Street, Ottawa, Ont., Canada K1P 5G4; $30.00 CAN.

Brooklyn Union Gas Co. is among the 5 largest gas distribution companies in the United States, serving 3 boroughs of New York City, the most densly populated area in all the United States. The paper gives a description of the system and its customers, its financial status, and a task force established 7 years ago to study the industry and its directions. The paper also describes pipeline projects for increased supply and the contracts recently negotiated with Shell and Enron for long-term supply. In conclusion, an overview of the supply and demand balance for the entire United States is given.

38028 (CANWEC–1989, pp. 43-45) **Natural gas. What the future holds perspectives of a major Canadian distributor.** Martin, R.W. (Consumers' Gas Co. Ltd.). Canadian National Committee,

World Energy Conference, Ottawa, ON (Canada). [1989]. (CONF-8811238–: 11. Canadian national energy forum, Calgary, Canada, 21-22 Nov 1988;CE–02686). In *Energy in Canada. The potential, the markets and the money.* Available from Canadian National Committee World Energy Conference, Suite 305, 130 Albert Street, Ottawa, Ont., Canada K1P 5G4; $30.00 CAN.

This paper, while admitting to a degree of truth in the view that natural gas markets are almost saturated in the traditional commercial areas of heating and water heating applications, points out what opportunities still exist in the non-traditional residential heating market (pool heater, fireplaces, ranges, driers), in natural gas as a transportation fuel, in urban public transit, in intercity trucking, and in cogeneration and combined cycle electricity generation.

38029 (DOE/EIA–0355) **The Natural Gas Market Model: Equations and data sources.** Werbos, P.J. USDOE Energy Information Administration, Washington, DC (USA). Office of Statistical Standards. Nov 1981. 50p. Sponsored by DOE Management & Administration. Order Number DE89014986/JAW. Available from NTIS, PC A04/MF A01 - GPO - OSTI; GPO Dep.

In 1981, EIA began a major study of the impact of natural gas deregulation. Through 1981, the major product of that study was the August 1981 EIA analysis paper entitled "Analysis of Economic Effects of Accelerated Deregulation of Natural Gas Prices." That paper will be referred to as the "Deregulation Study" below. The Natural Gas Market Model (NGMM) was the primary model used to produce the forecasts discussed in the Deregulation Study. A modified version of NGMM has been used in the initial runs of the EIA Extended Short-term Forecasting System (ESFS), which is still under development. The purpose of this paper is to provide a comprehensive description of what NGMM is, and of the inputs used with NGMM for the Deregulation Study. The Deregulation Study, and the many documentation reports it cites, contain much information about the substantive studies which led up to the forecasts; however, it does not provide enough detail on how these studies were brought together to permit either a replication or an in-depth evaluation of the forecasts. EIA standards require that models be documented in enough detail to permit replication. This report attempts to fill that gap in documentation, on the basis of a line-by-line audit of the model code, interviews with the model developers, and a replication of the model in the user-oriented system Troll. The report mentions the mechanics of how the solutions are obtained, but not in complete detail. 2 figs., 6 tabs.

0320 Transport, Pipelines, and Handling

Refer also to citation(s) 38024, 38519

38030 (CANWEC–1989, pp. 49-51) **Perspectives of the United States pipeline industry.** Jones, V.T. (Williams Co., Inc., Tulsa, OK, USA). Canadian National Committee, World Energy Conference, Ottawa, ON (Canada). [1989]. (CONF-8811238–: 11. Canadian national energy forum, Calgary, Canada, 21-22 Nov 1988;CE–02686). In *Energy in Canada. The potential, the markets and the money.* Available from Canadian National Committee World Energy Conference, Suite 305, 130 Albert Street, Ottawa, Ont., Canada K1P 5G4; $30.00 CAN.

This paper presents an overview of the present and future natural gas industry, particularly in government regulatory involvement and its effects on pipelines. The paper generally concurs with wellhead decontrol while taking exception to the methods used to deal with high and low-priced contracts. The problem with take-or-pay is discussed, as well as the more general problem of the role of the pipelines, or the merchant function issue. Access to retail markets is also a problem. The paper concludes with a general discussion of the supply and market situation in the U.S. to the mid-1990s.

38031 (GAO/RCED–87-133BR) **Natural gas regulation.** General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. 1988. 55p. Available from US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

Federal Energy Regulatory Commission Order 436 established a voluntary program for the transportation of natural gas through pipelines without prior FERC approval if the services are provided on a nondiscriminatory basis. FERC believed the Order would improve the ability of pipeline customers to obtain access to competitively priced supplies of natural gas. Twenty-six of the 45 major interstate natural gas pipelines have applied to participate in the Order 436 transportation program. FERC has implemented the program largely through its processing of pipeline applications to participate in the program and has allowed interstate pipelines, under certain conditions, to continue to transport gas without having to comply with the provisions established in Order 436.

0340 Combustion

Refer also to citation(s) 38637

04 OIL SHALES AND TAR SANDS

Refer also to citation(s) 37938

38032 (AOSTRA–1988) **UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.** Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. vp. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

Subjects covered in this volume of papers from a conference on heavy oil and oil sands included: surface facilities, mainly concerning steam generation; geochemistry of oil sands and heavy oils; biological markers and their uses in geochemistry; combustion properties and in-situ combustion methods; coke utilization; heavy crude and bitumen transport; properties of heavy oils, bitumens, and emulsions; and the retorting and mining of oil sands. Separate abstracts have been prepared for 46 papers from this volume.

38033 (AOSTRA–8808, pp. 16) **Development planning of Venezuela's Orinoco Oil Belt Field.** Achong, C.H. (Petroleos de Venezuela, S.A., Caracas, Venezuela). Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

Venezuela's Orinoco Heavy Oil Belt Field accumulations have been known since the early 1930s. By the mid-70s, a total of 116 wells had been drilled, mainly for concession appraisals. Upon nationalization, an evaluation program was undertaken in the oil belt, aimed at investigating, evaluating, and planning its development. An important result of this campaign was the confirmation of oil-in-place estimates in the order of 1.18 trillion bbl. The Heavy Oil Belt Field reserves correspond to heavy and extra-heavy crudes (4-12^0) American Petroleum Institute, with high viscosities, predominantly saturated, armomatic, resin-asphaltened. Sulfur and metal contents are high. The crudes are preferentially located in the basal, nonconsolidated Tertiary Age sands at depths of 500 to 3500 ft. The trapping mechanism is essentially stratigraphic. Due to the rather high formation temperatures, the crude is movable at reservoir conditions and consequently, producible by conventional means. In-depth evaluation in the experimental phase has permitted the definition of reliable production schemes. The modular concept is a convenient development strategy in light of unstable market conditions. An economical alternative has emerged, ORIMULSION. A planning methodology for Venezuela's Orinoco field has been devised that allows programming its development in an integrated manner, incorporating numerical simulation of source areas, the modular production concept, new viscous crude transportation methods, and a promising marketing option, within the frames of a technical-economical optimization. 6 refs., 8 figs., 3 tabs.

38034 (AOSTRA–8808, pp. 17) **Development of Alberta's oil sands.** Houlihan, R.N. (Energy Resources Conservation Board, Calgary, AB, Canada); Evans, R.G. Alberta Oil Sands Technology

and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807--: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE--02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

There are currently two large scale commercial surface mining operations exploiting the Athabasca oil sands deposit. A few hundred miles south, in the Cold Lake deposit, seven more commercial in situ projects have begun cyclic steam recovery of bitumen. A similar distance to the west, one large project utilizing novel steam flooding technology is recovering bitumen from the Peace River oil sands deposit. This paper outlines the nature and extent of these resources underlying Alberta's ground surface, and focuses on the technological developments that have occurred in some of the larger and more advanced projects. The evolution of the technology, including upgrading, and the outlook for future developments are dealt with, with emphasis on process efficiency, reliability, and cost reduction. As well, attention is given to environmental aspects of the various technologies, and to the marketing and transportation of the products. 13 refs., 11 figs., 3 tabs.

38035 (DOE/FE--0131) **Oil shale program plan, FY 1989.** US-DOE Assistant Secretary for Fossil Energy, Washington, DC (USA). Office of the Deputy Assistant Secretary for Oil, Gas, Shale and Special Technologies. Jun 1989. 25p. Sponsored by DOE Fossil Energy. Order Number DE89013914/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The oil shale program is directed to the development of advanced technologies for extracting shale oil from the large domestic resources. The overall goal is to foster development of an economically competitive and environmentally acceptable oil shale industry. A series of technology development steps must be taken by DOE, other government agencies and other governments and/or industry to achieve this goal. They include basic and applied R and D, proof-of-concept activities, first-of-a-kind field tests and associated commercial-scale activity. Activities associated with the oil shale program are designed to: Expand the technically recoverable resource base, increase recovery efficiency, reduce capital and operating costs and/or enhance environmental acceptability. In support of the overall program goal, oil shale research has two major technical goals: (1) Technology Base Development. To produce an engineering and scientific information base for industry use in designing and developing oil shale processes with reduced costs and enhanced environmental acceptability and to foster the development of novel oil shale processes and, (2) Environmental Mitigation. To develop a comprehensive data base on pollutant generation and the steps required to mitigate the impacts in a cost-effective manner. This report discusses the above goals. 9 refs., 1 fig., 1 tab.

0401 Reserves and Exploration

Refer also to citation(s) 38048, 38084, 38088

38036 (AOSTRA--8808, pp. 12) **Orinoco oil belt reservoir quality and potential. A geostatistical appraisal.** Taheri, M. (INTEVEP, S.A., Venezuela); Chin-A-Lien, M.; Rodriguez, E.; Young, G. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807--: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE--02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

Factors crucial in the exploitation of heavy crude oils in a pilot area (Arecuna Field, Hamaca Area) of the Orinoco Oil Belt, Venezuela, have been thoroughly analyzed so as to understand the combined influence of geological, petrophysical, and production parameters on reservoir behavior. These parameters were coded, normalized, and evaluated in 25 productive horizons of the Miocene Oficina Formation. Subsequently, potential production areas were delineated and correlated with the sedimentary facies present, utilizing multivariate statistics. It was found that the best productive areas are mostly located within the axial and distal parts of distributary channel systems, which in this pilot area trend in a south-north direction. Applied geostatistical methods (such as characteristic analysis) indicated that porosity, total sand and net oil sand thickness, oil saturation, resistivity, permeability, shaliness, viscosity, and American Petroleum Institute gravity are the principal parameters that influence reservoir quality. The methodology developed in this study, which takes into account the combined effects of multiple subsurface parameters on production, can be applied to the rest of the Orinoco Oil Belt as well as to other areas for the optimum selection and development of prospective areas. 16 refs., 8 figs., 4 tabs.

38037 (AOSTRA--8808, pp. 19) **Characteristics and potential of U.S. heavy oil resources.** Kuuskraa, V.A. (ICF, Inc., Fairfax, VA, USA); Godec, M.L. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807--: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE--02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

This paper summarizes the results of a comprehensive study of the heavy oil potential in the United States. This includes a review of the size, location, and characteristics of the heavy oil resource base and an estimate of the ultimate recovery and productive potential of domestic heavy oil. The U.S. heavy oil resource base consists of approximately 100 billion barrels of oil in place, 80 billion barrels of which exist in about 250 large (greater than 20 million barrels in place) reservoirs. About 11.7 billion barrels of this resource were put into production through 1985, and another 2.8 billion barrels of heavy oil are included in booked U.S. reserves. Estimated recovery of U.S. heavy oil by conventional thermal enhanced oil recovery (EOR) processes (those currently practiced) ranges from 4 to 9 billion barrels at oil prices of $15 to $25 per barrel. Crude oil prices greater than $25 per barrel will be required for thermal EOR to be economically attractive in most settings outside California. The study predicts that oil production from domestic heavy oil will range from current rates of about 500,000 barrels per day to about 750,000 barrels per day by the mid-1990s if oil prices increase to above $25 per barrel. The study concludes by arguing for further R&D in thermal recovery research and improved process economics. 17 refs., 15 figs., 4 tabs.

38038 (CHOA--8711) **Reservoir description. Proceedings [of the] sixth quarterly meeting of the Canadian Heavy Oil Association.** Canadian Heavy Oil Association (Canada). 1987. vp. (CONF-8709445--: 6. quarterly meeting of the Canadian Heavy Oil Association, Calgary, Canada, 22 Sep 1987;CE--02643). Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $N/C.

The subjects covered by papers presented at a meeting concerned with heavy oil reservoir description included seismic surveys, seismic data analysis, thermal well testing, statistically-based well log analysis, and expert systems for log analysis. Separate abstracts have been prepared for five papers from this meeting.

38039 (CHOA--8711, pp. 13) **Log analysis of heavy oil using an expert system.** Pepperdine, L. (D & S Knowledge Systems, Inc.). Canadian Heavy Oil Association (Canada). 1987. (CONF-8709445--: 6. quarterly meeting of the Canadian Heavy Oil Association, Calgary, Canada, 22 Sep 1987;CE--02643). In *Reservoir description. Proceedings [of the] sixth quarterly meeting of the Canadian Heavy Oil Association.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $N/C.

This paper describes the interactive use of an expert log analysis system to evaluate a heavy oil well. The system's inference engine(EXPERT) was used to build a routine of algorithms for the analysis. Each of the six functions of LOG/MATE ASSISTANT (database, algorithm processor, interactive graphics, report generator, data communications, and inference engine) was used in the analysis. The data and results of the use of each function in the analysis of the heavy oil well is detailed. The LOG/MATE ASSISTANT expert system is a completely interactive and totally data driven expert computer system. The user has complete control from the data

input to the reports that are generated. Additionally the user can describe the log analysis problem in terms of functions, frames, rules, pre-conditions, post conditions and primitives. The expert system is a frame based organization of functions to reason about the log analysis problem. The EXPERT distinguishes between abstract functions, reasoned about by name, and algorithms, or syntatic representations for computing a funciton. While it reasons about abstract functions, it also executes algorithms to produce values to assist in the reasoning process for log analysis. Algorithms have been modified from the standard log analysis routines to cope with the vagaries of unconsolidated heavy oil sands. The differences and adjustments to the expert system are noted. 2 refs., 9 figs., 1 tab.

38040 (CHOA–8711, pp. 21) **Quantitative application of seismic data for heavy oil projects.** Mummery, R.C. (Teknica Resource Development, Ltd., Calgary, AB, Canada). Canadian Heavy Oil Association (Canada). 1987. (CONF-8709445–: 6. quarterly meeting of the Canadian Heavy Oil Association, Calgary, Canada, 22 Sep 1987;CE–02643). In *Reservoir description. Proceedings [of the] sixth quarterly meeting of the Canadian Heavy Oil Association.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $N/C.

Seismic inversion techniques were applied to some data from a heavy oil pilot project in the Cold Lake heavy oil region of eastern Alberta. The original seismic data used in the study were acquired on a heavy oil lease from the Marguerite Lake stimulation project. This pilot project has operated for several years and provided an excellent opportunity to evaluate the effectiveness of using seismic tecniques to measure movement of the stimulation front. Seismic surveys were conducted in successive years to determine whether observable changes could be recognized within the reservoir (Clearwater sands) units. Data from this 3-dimensional grid were preprocessed from field tapes to enhance the frequency content necessary for inversion. The results of this study indicate that quantitative data can be obtained which relate directly to the stimulation of the reservoir units. The factors which influence the ability of seismic data to measure stimulation effects the discussed. These factors include reservoir parameters, stimulation techniques, acquisition parameters, seismic processing and quantification of the results using inversion (Seislog). Specific examples of data from the Marguerite Lake Pilot project are used to illustrate these factors. 7 figs.

38041 (CHOA–8711, pp. 14) **3-D seismic and heavy oil. A natural combination.** Matthews, L. (Western Atlas Canada, Ltd.); Jackson, R.; den Boer, L. Canadian Heavy Oil Association (Canada). 1987. (CONF-8709445–: 6. quarterly meeting of the Canadian Heavy Oil Association, Calgary, Canada, 22 Sep 1987;CE–02643). In *Reservoir description. Proceedings [of the] sixth quarterly meeting of the Canadian Heavy Oil Association.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $N/C.

Three-dimensional seismic monitoring is a potential technique for providing information about formation stratigraphy in heavy oil deposits and for monitoring subsurface heat movement during in-situ recovery. In order to achieve the required seismic expression for mapping both the heat fronts and stratigraphy, it is necessary for the field data to have an extremely high signal-to-noise ratio over a broad frequency band. Techniques to obtain this degree of resolution have been tested at the Gregoire Lake In-Situ Steam Pilot (GLISP), located 50 km south of Fort McMurray. The project was designed to test a steam stimulation process, and the overall methodology for monitoring heat movement over time consisted of rock properties studies, computer modelling, seismic field tests, stratigraphic interpretation, and heat zone imaging. Seismic test results indicated that by using buried seismometers and very light charges, a dramatic improvement in signal-to-noise ratio and the high-frequency content of the data, compared to standard techniques, was possible. Very high quality field data were obtained, enabling interpretation of the pushdown and character change effects occurring in the formation. 2 refs., 8 figs.

0403 Drilling, Fracturing, and Mining

Refer also to citation(s) 38049

38042 (AOSTRA–1988, pp. 15) **Geotechnical considerations in borehole hydraulic mining of oil sands OSLO new technology.** McRoberts, E.C. (Hardy BBT Ltd.); Cavers, D.S.; Paul, R. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

Borehole Hydraulic Mining (BHM) is a mining method in which access to mineral deposits is gained by a borehole and the actual cutting of the mineral bearing rock is by a high pressure water jet directed from a mining tool that is lowered into the borehole. The water jet cut mineral is slurried and pumped to surface. The pump is an integral part of the mining tool. In the case of oil sands, the bitumen recovery could take place either on surface or in the cavity itself. At the end of cavity life, the cavity is backfilled with spent sands and then closed. During the mining and backfilling operations, the cavity integrity needs to be maintained so that optimum recovery of bitumen is realized from the cavity. This paper, after describing the BHM techniques, focuses on the factors that influence the cavity stability and postulates some solutions. 6 refs., 8 figs., 1 tab.

38043 (AOSTRA–1988, pp. 8) **Evaluation of the operating characteristics of a shovel and truck fleet on the Clearwater Formation overburden.** Isaac, R.A. (Syncrude Canada Ltd., Fort McMurray, AB, Canada); Lord, E.R.F. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

The overburden at Syncrude Canada's oil sand mine is increasing in depth as the oil sand mine is developed. At the moment, Pleistocene clays/tills and reject oil sand form the majority of the overburden. In the near future the dominant material will be the Clearwater Formation clay shale for which there is little operating experience. In 1983, a large test pit (150,000 m^3) was excavated into the Clearwater Formation clay shale to assess the operating characteristics of a shovel/truck mobile fleet. Shovel production, bearing capacity, trafficability of 170-ton trucks, and dump stability were investigated. This paper reviews the field test and some of the key findings. 5 figs., 3 tabs.

38044 (AOSTRA–8808, pp. 13) **The present state and propects of technology development for thermal mining of heavy oil.** Tabakov, V.P. (All Union Oil and Gas Scientific Research Inst., USSR); Gurov, E.I.; Tiunkin, B.A. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

The mining method of oil recovery consists in oil recovery with the underground well system, constructed in the mine, rather than with conventional wells drilled from the surface. This article describes the development experience with the Jarega oil field, 1300 km northeast of Moscow. Initial oil recovery was less than 4%. In 1972, the thermal mining techniques were applied in the three mines. Most commonly used is the double-level system of thermal mining development. From the overlying formation, located 20-30 m above the pay-bed top, a heat carrier (steam, for example) is injected into the reservoir through the vertical and inclined wells. Oil withdrawal is carried out through the gently rising producing wells, 100-250 m in length, drilled from the production galleries located inside the pay-bed. The area of a single developed zone is 10-15 hectares. Reservoir cyclic steam injection is performed through the injection wells. The ultimate oil recovery factor increases to 45-55%. Underground wells (vertical, slanted, horizontal) can be drilled to a substantial length; for instance, the PBS-2T drilling machine drills

underground wells to a distance of 300 m, with the maximum well diameter being 370 mm. Other systems of oil field development are being tested in the Jarega oil field. Currently, 3700 tonnes of steam are daily injected and 1300 tonnes of oil are produced. The article finally discusses the screening criteria for the applicability of the thermal mining technique. 2 refs., 10 figs., 1 tab.

0404 Oil Production, Recovery, and Refining

Refer also to citation(s) 37951, 37953, 37954, 37956, 37962, 37963, 37964, 37965, 37966, 37967, 37968, 37969, 37970, 37971, 37972, 37977, 37978, 37985, 38005, 38044, 38082, 38083, 38093, 38689, 38751

38045 (AOSTRA–1988, pp. 8) **Fouling in the coker gas oil hydrotreater guard reactor.** Sanford, E.C. (Syncrude Canada Ltd., Edmonton, AB, Canada); Kirchen, R. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

Syncrude Canada has been experiencing fouling problems in the gas oil hydrotreater guard reactors since startup of its upgrading plant. Fouling, leading to a high pressure drop, followed a cyclical pattern. After a turnaround, when fresh catalyst was loaded, pressure drop problems were experienced after approximately nine months of operation, and were believed to be due to crust formation on top of the catalyst bed. After skimming the reactor, pressure drop problems were experienced after approximately three months and were attributed to plugging by fines. Subsequent skims produced similar results. Measurement of the thermal fouling tendency of the gas oil feed, analysis of both the crust on the top of the reactor and the fines found in the bed and a complete evaluation of run histories led to the conclusion that the guard reactor acts as a deep bed filter. One way to maximize the length of guard reactor runs is to increase the void volume in the reactor. Recommendations were made based on using different catalyst shapes and sizes, and these were implemented in the plant. An up-to-date run history of the guard reactor after implementing the new loading strategy is presented. 3 refs., 2 figs., 2 tabs.

38046 (AOSTRA–1988, pp. 10) **Recycle oil pyrolysis and extraction of tar sand.** Cha, C.Y. (Western Research Inst., Laramie, WY, USA); Guffey, F.D. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

A new pyrolysis process called ROPE (Recycle Oil Pyrolysis and Extraction) is being developed for recovering products from tar sands that require a minimum of upgrading to produce finished, marketable fuels or that can be used as a diluent to decrease the pour point of bitumen for transportation. The concept consists of two pyrolysis steps: retorting tar sand at a lower temperature ($< 420^0$C) with the bitumen and product oil, and completing the pyrolysis of the residue at a higher temperature ($> 420^0$C) in the absence of product oil recycle. Three tar sand resources, Asphalt Ridge (Utah), Sunnyside (Utah), and Athabasca (Alberta), have been investigated using a 2-inch-diameter process development unit. Experimental results from three tar sands indicate that oil yields from the ROPE process will be greater than those from conventional pyrolysis processes. The product oils produced from each of the resources have been evaluated using selected analytical techniques. Differences were observed in the characteristics of the distillable liquid products from the three resources. These differences are discussed in relation to the potential end uses of the products. Depending upon the characteristics, unleaded gasoline blending stocks, diesel fuels, and aviation fuels can be produced. 4 refs., 2 figs., 8 tabs.

38047 (AOSTRA–1988, pp. 14) **Use of oxygen enhanced air to produce the heavy oil and tar sands of Texas.** Pate, B. (Texas A&M Univ., Texas, USA); Edmonds, G.; Crawford, P.B. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

Texas originally had approximately 35 billion barrels of heavy oil and tar sand in place. Of this amount it was anticipated that five billion barrels could be produced. Texas has approximately five billion barrels of tar sand, none of which is being produced economically today. In-situ combustion and steam injection are both being used in some heavy oil fields, but neither process has received wide application in Texas. Few oil reservoirs there appear suitable for either air in-situ combustion or steam. Laboratory and field tests have been made using oxygen or oxygen enriched air for in-situ combustion of the Texas crude oils. The use of oxygen would appear to have some advantages over the use of air alone. Economics have been developed for oil production by both air and oxygen. There appears to be a practical operating range in which the use of oxygen enriched air may be superior to the use of air alone for oil production by in-situ combustion. 8 refs., 11 figs., 3 tabs.

38048 (AOSTRA–8808) **UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.** Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. vp. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

These proceedings deal with enhanced heavy oil recovery as well as with heavy oil reserves and the economics of heavy oil. Waterflooding, alkali flooding, and steam injection are studied from the points of view of oil yield and energy efficiency. Experience in Canada, Venezuela, China, and the USSR is presented, as are mathematical models for the choice of a strategy of recovery, including many computer simulations. These proceedings also discuss heavy oil reserves in Alberta, California, Venezuela, China, Iran, and in the Arabo-Persian Gulf. A survey of chemical analyses of samples from heavy oil deposits around the world is presented. The oil sands industry in Alberta is presented historically; its economic environment and its significance for Canada's energy future are discussed. Separate abstracts have been prepared for 44 papers.

38049 (AOSTRA–8808, pp. 7) **Heavy oil and tar sands recovery technology in the year 2000 and beyond.** Stosur, G.J. (U.S. Dept. of Energy, Washington, DC, USA). Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

For the remainder of this century, the technology applicable to the recovery of heavy oil and bitumen from tar sands is expected to evolve gradually. Rather than breakthroughs in technology, small but significant improvements are envisioned to increase production efficiency and to lower operating costs. Most of these improvements are expected to be based on inexpensive and widely available computer technology that will allow increased operational efficiency. Other technical advances will include the development of computer based expert systems for selected areas of technology, improvements in the area of reservoir sweep efficiency and profile control, routine use of horizontal wells where unusual conditions favor their deployment, development of systems for improved description of heterogeneities on the interwell scale, and significantly improved techniques for tracking the movement of thermal fronts in time and in space. The truly long term picture for heavy oil and tar sands remains relatively unchanged, despite the sharp reduction of oil prices in 1986. Supply shortfall is expected to develop in the 1990s when

petroleum prices begin to rise again as the result of the depletion of conventional (light) petroleum and continued economic growth, particularly in the less developed countries. This shortfall will be increasingly filled by heavy crudes and bitumen from tar sands. 6 refs., 6 figs.

38050 (AOSTRA–8808, pp. 10) **The application of thermal well testing to reservoir description.** Poon, D.; McGee, B.; Gozde, S.; Best, D. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

This paper presents a review on the techniques of thermal well testing and the evaluation of the analysis methods using the test data obtained from the thermal pilots of the Alberta Oil Sands Technology and Research Authority (AOSTRA). Thermal well testing is the transient pressure analysis of wells in a thermal recovery process such as steam stimulation, steam flood, or in situ combustion. A theory for the analysis of thermal well testing has been developed and later applied to analyze the pressure falloff data of the steam and in situ combustion injection wells. AOSTRA and its industrial partners have been testing the thermal in situ recovery of bitumen from various oil sand deposits in Alberta. During the operation of these pilots, many pressure falloff tests have been conducted. It was found that the pressure falloff test data are generally consistent with the predictions of a composite reservoir model. The analysis results provided useful information regarding the wellbore damage or stimulation during the injection history of the well. In addition, it was demonstrated that the pressure falloff tests can be used to monitor the combustion process by determining the volume, thermal efficiency, and fuel concentration of the burnt zone. These parameters are essential for estimating the energy requirement of the in situ combustion process. Finally, the test results seemed to demonstrate the effects of steam override and bottomwater sand. With the experience gained from further field tests, it was felt that thermal well testing could become a useful tool for studying the reservoir behavior and monitoring the thermal recovery processes. 9 refs., 11 figs.

38051 (AOSTRA–8808, pp. 12) **Injected fluid front determination using pressure data in thermal oil recovery projects.** Ramones, M. (Petroleos de Venezuela, S.A., Caracas, Venezuela); Negron, E. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

During a thermal oil recovery project, it is possible to detect the injected fluid front location through observed pressure vs time data. The importance of locating the fluid front lies in the fact that it is possible to determine the hydrocarbon volume swept and to evaluate the thermal efficiency of the process knowing the injection parameters: total amount of fluid injected, heat losses, bottom hole injection conditions, reservoir and fluid properties, etc. Project progress in thermal oil recovery may be analyzed from an evaluation of the thermal efficiency and from the displaced to produced fluids ratio. A description of the MODCWTES computer program is presented. This program allows for the determination of the hydrocarbon swept volume based on pressure falloff data. Additionally, a theoretical description of the methodology used for its development, as well as field test data analyzed with the use of this tool, are presented. The data have been obtained from steam injection and in situ combustion field projects reported in the literature. Some of the results have been satisfactorily compared with computer simulation runs and with temperatures recorded in observation wells, proving the usefulness of the program. 12 refs., 10 figs., 2 tabs.

38052 (AOSTRA–8808, pp. 17) **Optimization of primary exploitation strategies for heavy oil reservoirs.** Miranda, J. (PDVSA, Venezuela); Ashford, F.E. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

In order to simulate the performance of typical heavy oil reservoirs located in the Orinoco Heavy Oil Field in Venezuela, two reservoir models were constructed: one to simulate the specific behavior of the MFB-109/U2 sand reservoir of the Bare block, and a second to simulate a more general type of reservoir of the Hamaca area. Confidence in the predictive models was obtained by a satisfactory history match of the production performance of the MFB-109/U2 sand reservoir. Modelling of a water/oil transition zone was required to match the water-oil-ratio history. Introducing uncommonly low values of gas relative permeabilities for the gas saturations was necessary to simulate the movement of a mixture of oil and discrete noncoalescent gas bubbles, to obtain an acceptable match of the gas-oil-ratio history. The models, in the prediction mode, were used to evaluate the sensitivity of heavy oil reservoir performance at various operating, development, and completion strategies as well as for well spacing, and aquifer size analyses. The sensitivity study results indicated that a crestal development strategy is to be recommended along with maximizing pressure drawdown in the producing wells. Some aquifer support and closer well spacing enhance oil recovery. 5 refs., 11 figs.

38053 (AOSTRA–8808, pp. 18) **Interpretation of field tests of cyclic steam/gas injection in the Tia Juana Field Bolivar Coast, Western Venezuela.** Salazar, A. (Petroleos de Venezuela, S.A., Caracas, Venezuela); Sanchez, N.; Martinez, E.; Colonomos, P. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

Pilot tests of cyclic steam followed by gas injection have been carried in heavy oil reservoirs (986-1000 kilograms/m^3, 10-12^0 of the American Petroleum Institute) of the Tia Juana and East Tia Juana Fields, Bolivar Coast, western Venezuela. The tests in the Tia Juana Field were performed during a first cycle, with an increase of up to 20% in the oil production due to the gas injection. The tests in the East Tia Juana Fields were performed during a fourth cycle, with no significant change in the oil recovery. The pilot tests were successfully simulated with a three-dimensional compositional thermal numerical model, including 36 years of production during depletion and the three cycles prior to the steam/gas stimulation in the East Tia Juana Field. A sensitivity study with varying gas injection conditions and reservoir conditions at the start of the steam/gas stimulation was conducted. The results indicate that the extra production due to the injection of gas, is highly sensitive to the pressure of the reservoir at the start of the injection. This result confirms the observed field behavior. Solution gas drive is the mechanism responsible for the increase of production due to the injection of gas. This effect is more important at the higher pressures normally present during the first stimulation cycles. Other factors such as changes in saturations and oil phase viscosity reduction are not deemed to be of much importance. 17 refs., 11 figs., 7 tabs.

38054 (AOSTRA–8808, pp. 15) **Evolution of technology for commercial bitumen recovery at Cold Lake.** Gallant, R.J. (Esso Research Canada, Ltd., Calgary, AB, Canada); Dawson, A.G. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

Since 1964, an extensive amount of experimental data and operating experience has been acquired that has enabled Esso

Resources to begin commercial development of the Cold Lake resource. The majority of the experimentation was conducted at the Leming Pilot, developed in 1975. The objectives were to assess and demonstrate the economic viability of potential recovery processes, maximize economic recovery in good quality reservoir, and to develop operating strategies that would be appropriate for future development and operations. The Leming experimental pilot has evaluated a wide range of recovery schemes, as well as many variations in operating parameters and equipment configuration. Some of these included hot water and steam bank floods, chemical injection, horizontal wells, varying steam cycle sizes and rates, varying spacing and aspect ratios, and varying well casings designs and completions. Investigations will continue in the areas of reservoir fracturing, well spacing, the effects of reservoir pressure, optimum management of well-to-well communications, infill well operation, and well casing impairment mechanics and prevention. Cyclic steam stimulation continues to be the most favorable process in early cycles, but optimization of the process variables is complex, due to their interdependency. Experimentation is ongoing to further optimize the cyclic steam stimulation process, and to investigate alternative or follow-up recovery processes. 3 figs., 1 tab.

38055 (AOSTRA–8808, pp. 12) **Demonstration of the high conversion H-Oil process on Cold Lake vacuum residuum.** Colyar, J. (Hydrocarbon Research, Inc., Lawrenceville, NJ, USA); Harris, E.; Popper, G. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

A 41 day, high conversion demonstration program on Cold Lake vacuum residuum was successfully conducted by Hydrocarbon Research, Inc., in their 30 bbl/d H-Oil Process Development Unit. The liquid products from the test were blended with virgin Cold Lake material and hydrotreated to achieve Alberta Oil Sands Technology and Research Authority synthetic crude specifications. During the H-Oil Process Development Unit test, smooth uninterrupted operation at a steady-state equilibrium catalyst activity was experienced. Residuum conversion levels of 86 and 92 vol % were demonstrated for 9 and 21 days, respectively. High conversion was achieved through use of the Vacuum Bottoms Recycle Processing Technology, patented by HRI. Synthetic crude yields (C_4-524^{0}C) exceeded 100 vol % of the vacuum feed material, which is a 15% increase over conventional upgrading technologies. The success of the test demonstrates the commercial readiness of the high-conversion H-Oil process. Sufficient operating and process performance data on Cold Lake feed were obtained to provide a basis for the design and guarantee of commercial upgrading facilities. 7 figs., 9 tabs.

38056 (AOSTRA–8808, pp. 14) **Upgrading of Alberta derived bitumen applying the VLC/VCC-technology.** Niemann, K. (VEBA OEL A.G., Gelsenkirchen-hassel, West Germany); Kretschmar, D.-I.K.; Rupp, M.; Merz, L. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

The VEBA Combi Cracking (VCC) technology directly combines the hydroconversion of heavy residual oils with the hydrofinishing of the primary synthetic crude, thus providing maximum conversion rates of > 94% and high-grade product properties in one and the same process. Two extensive test runs with Cold Lake and Athabasca bitumen were performed in a 200 bbl/d VCC pilot plant. Both residual oils were converted into more than 103 vol % of distillates (C_4-500^{0}C) containing naphtha (17-20 %), middle distillates (27-30%), and vacuum gas oils (50-55%). The VCC naphtha has to be reformed, VCC middle distillates and jet fuels are directly marketable, and the vacuum gas oil is an excellent feedstock for hydrocrackers or FCC plants. Following the VCC pilot plant test the hydrogenation residue produced was successfully coked in VEBA OEL's low temperature carbonization plant. By means of this residue carbonization, it was possible to achieve an overall conversion of 98 wt%. Scale-up models are available that are substantially checked against the Bottrop VCC plant now in operation with a capacity of 3500 bbl/d, and commercially-sized VGO treaters. All data necessary to design a unit for the upgrading of Alberta-derived feedstocks as well as the required guarantee data are available. With a view to the economic prospects of bitumen recovery in general, which are not too bright, VCC offers the highest probability of achieving the break-even point. 10 refs., 12 figs., 5 tabs.

38057 (AOSTRA–8808, pp. 8) **Upgrading of Cold Lake heavy oil in the CANMET hydrocracking demonstration plant.** Pruden, B.B. (Petro-Canada Products, Mississauga, ON, Canada); Denis, J.M.; Muir, G. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

This paper describes the operation of the CANMET Hydrocracking Demonstration Plant with vacuum tower bottoms (VTB) from Cold Lake heavy crude oil. This plant is located in Petro-Canada's Montreal refinery, and has a nominal capacity of 5000 bbl/d. The feedstock originates from the steam stimulation of heavy oil deposits in Cold Lake, Alberta. The plant operated at 86 wt% conversion with no evidence of coking. While the duration of the test did not permit further optimization, analysis of the test run results confirmed that uncontaminated Cold Lake VTB would achieve over 90% conversion. This is a successful demonstration of one of the main features of the CANMET Hydrocracking Process, i.e. high conversion in a single-stage reactor with no recycle of residue pitch, heavy ends, or gas oil. The demonstration unit's operation was predictable and straightforward. Upsets due to external factors were accommodated in a smooth reaction response with ample time for process adjustment. Commercial projections and economics are discussed for an upgrader to process 30,000 bbl/d of Cold Lake VTB. 5 refs., 3 figs., 4 tabs.

38058 (AOSTRA–8808, pp. 12) **Hydrocracking of vacuum residue of bitumen: radioactive tracer and reaction kinetic studies using a high temperature-high pressure tubular reactor.** Oezuem, B. (Alberta Research Council, Devon, AB, Canada); Lewkowicz, L.; Cyr, T.; Oguztoeseli, M. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

A radioactive tracer technique has been employed to study high temperature, high pressure bubble-column reactor hydrodynamics. The reactor has been used to study the catalytic hydrocracking of bitumen. Radioactive isotopes, iodine (^{131}I) and xenon (^{133}Xe), were injected into the liquid and gas phases respectively at the inlet of the reactor. Tracer concentration measurements at the reactor exit were interpreted using a mathematical model describing the hydrodynamiccs of the bubble column. The model was composed of a coupled system of one-dimensional, time dependent differential mass balances including accumulation, convection, dispersion, and interfacial transfer terms. Dynamic parameters of gas hold-up, liquid and gas phase Peclet numbers, and the interfacial area/mass transfer coefficient were estimated using numerical simulation to obtain the best fit of model predictions to experimental data. Hydrocracking reaction kinetics were modelled in terms of lumped chemical species. Kinetic rate constants with associated activation energies were calculated using an extended model to include first order liquid phase reaction terms. Results of tracer and reaction kinetic studies are essential for reactor engineering applications such as reactor scale-up, optimization, and control. 24 refs., 5 figs., 2 tabs.

38059 (AOSTRA–8808, pp. 26) **Mechanisms of sand retainment by wire-wrapped screens.** McCormack, M.E. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

Sand control techniques for oil production wells have frequently employed wire-wrapped screens. They have demonstrated a limited usefulness in the heavy oil and tar sands regions of western Canada; this limitation is due to the excessive restriction in oil production that frequently accompanies the installation of a wire-wrapped screen. It is commonly believed that fines plugging is the major problem in these situations. In a field where the main body of work is empirical trial and error tests, there are few published sources that discuss the mechanisms of sand retainment by wire-wrapped screens. The desirable properties for a wire-wrapped screen, when it is the sole sand retainment measure, are discussed. This paper concentrates on the study of multiple particle arches or "partial" sand retainment. For the theoretical portion of the study, the particles were assumed to be equal spheres and the arrangements were restricted to two dimensions. Basic rules of particle stability in the absence of friction were formed; they are dependent on the relative angles of contact between the particles and base plane. Calculations of particle arching and the effect of particle strength on arch stability are discussed. A series of 2- and 3-dimensional experiments were carried out with glass beads of nearly uniform size in an apparatus that allows for the visual observation of the packing arrangements formed, the stress field being supplied by gravity. The results of these experiments are presented. The applicability of this study to the design of wire-wrapped screens is discussed. 10 refs., 25 figs., 4 tabs.

38060 (AOSTRA–8808, pp. 14) **Interwell communication in cyclic steam projects.** Bitter, B.S. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

In multiwell cyclic steam projects, well interactions become apparent in the first few cycles. These interactions can be a result of increased reservoir pressure due to steam injection or of direct channelling of fluids from well to well. As in steamfloods, once injected fluids have broken through to a producer, the recovery process becomes much less efficient. Therefore, it is important to monitor the development of fluid communication, in order to adapt the operating strategy to maintain high oil production rates. This paper proposes a mechanism for the development of fluid communication channels. The communication progresses from pressure support phenomena and fingering of the flood fronts to the formation of heated channels between wells. This latter phenomenon allows the direct transfer of injected fluids to a production well. As the interwell communication develops, various stages can be identified from standard production and injection data. Characteristic phenomena associated with the stages of communication are described and illustrated. Several operating strategies designed to retard or cope with interwell communication are discussed. Finally, a group operating strategy is proposed to improve recovery from a cyclic steam project with extensive interwell communication. 11 refs., 12 figs.

38061 (AOSTRA–8808, pp. 12) **A comparison of formation reactivity in quartz-rich and quartz-poor reservoirs during steam assisted recovery.** Hutcheon, I. (Univ. of Calgary, Calgary, AB, Canada); Abercombie, H.; Shevalier, M.; Nahnybida, C. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

The injection of steam to assist in heavy oil recovery is known to alter reservoir mineralogy by mineral reactions. Theoretical arguments indicate that the composition of produced waters should reflect the nature of mineral reactions during thermal recovery. Sampling of produced waters demonstrates that mineral reactions do affect the composition of produced waters from heavy oil reseroirs in Alberta and Saskatchewan and are responsible for the production of substantial quantities of CO_2. The mineral reactions predicted from the compositions of produced waters involve illite, potassium feldspar, smectite, analcime, kaolinite, and chlorite. Quartz-rich reservoirs (Bodo) respond differently to steam injection than quartz-poor reservoirs (Tucker Lake). Quartz-rich reservoirs do not show any evidence of reactions between analcime and smectite, as is observed in quartz-poor reservoirs. The extent of mineral reactions during steam injection in quartz-rich rocks is probably less than in the quartz-poor rocks of the Cold Lake area. This is due to the more reactive mineralogy of quartz-poor reservoirs, typical of Cold Lake, compared to quartz-rich reservoirs typical of areas in southeast Alberta and western Saskatchewan. Geothermometers based on minerals reactions and fluid compositions give reasonable temperatures near the well bore in producing wells. Mineral reactions are capable of controlling the composition of the produced fluid, in spite of relatively high (in geological terms) volumes of water. This implies that additives to inhibit reactions in reservoirs of similar mineralogy should focus on ions or other substances not commonly found in hydrocarbon reservoirs. 32 refs., 6 figs.

38062 (AOSTRA–8808, pp. 16) **Foam transport modelling.** Law, D.H.-S. (Alberta Research Council, Edmonton, AB, Canada); Yang, Z.-M.; Stone, T. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

Foam injection has received increasing attention in enhanced oil recovery. As a permeability blocking agent, foam promises significant recovery of oil from underground oil reservoirs not otherwise recoverable by steam-only injection processes. A foam transport model has been developed, based on one-dimensional foam propagation laboratory experiments in the Alberta Research Council. This model is quite comprehensive in that it predicts the transport of the foaming agent (surfactant) and flow resistance due to the presence of foam. Mechanisms leading to surfactant losses in the water phase are all taken into account. The flow resistance of foam is modelled by reducing the relative permeability of the gas phase. In order to study the effect of the presence of foam on oil recovery, a field scale simulation was carried out with the model. It was found that the oil production in the foam injection process was higher than that in the steam-only injection process. 19 refs., 12 figs., 2 tabs.

38063 (AOSTRA–8808, pp. 16) **Fines migration in heavy oil reservoirs.** Coskuner, G. (Petroleum Recovery Inst., Calgary, AB, Canada); Maini, B. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Résources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

This paper presents a comprehensive review of currently available information on various factors that may affect fines migration in heavy oil reservoirs and identifies areas where further research is needed. Also presented are the results of experiments conducted in preserved cores from an unconsolidated, heavy oil reservoir in Alberta to investigate the effect of flow velocity and fresh water injection on fines migration. It is evident that formation damage that results from fines migration is a complex phenomenon affected by many factors. One of the factors that may affect fines migration in unconsolidated, heavy oil reservoirs is the net confining pressure.

The above mentioned experiments confirmed that this was the case. In particular, it was found that the critical velocity at which fines start to disperse and permeability starts to decline decreases with increasing net confining pressure. 67 refs., 5 figs., 1 tab.

38064 (AOSTRA–8808, pp. 16) **Porosity modification related to tar sand process water.** Mason, G.M. (Western Research Inst., Laramie, WY, USA); Yin, P.; Daley, R.L. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

Laboratory experiments were conducted to determine the effects of tar sand process water on the mineral components of a sandstone from a known tar sand deposit and on control samples of feldspars of varying compositions. Contact with the process water increased porosity and permeability in the test samples as a result of the dissolution of aluminosilicate minerals, with a corresponding precipitation of clay minerals. Once mobilized, ions from the dissolved mineral matter can be moved by a processing wave and later precipitate when geochemical conditions change. Clay minerals can occlude porosity, affecting process design and efficiency; additionally, they cause disposal and water recycling problems. 21 refs., 15 figs. 1 tab.

38065 (AOSTRA–8808, pp. 18) **X-ray CT applied to heavy oil corefloods.** Cuthiell, D. (Alberta Research Council, Edmonton, AB, Canada); Sedgwick, G. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

X-ray computed tomography (CT) is a technique originally developed for medical imaging which is now finding application in petroleum research. This nonintrusive imaging technique provides the capability to spatially resolve core structure and fluid saturations throughout the core on a scale of around a millimeter. CT can therefore be used to provide either static images of core interiors or on-line measurement of spatially and time varying saturations during dynamic core processes. This paper describes experiments performed using a second generation medical CT scanner which has been specially configured to monitor on-line heavy oil corefloods at steam-based in situ recovery conditions. Examples are presented of a number of dynamic coreflooding experiments involving hot water, steam and foam displacements. Several applications of the system to static core analysis are also discussed. In all of these cases, the result of CT scanning is a very large set of data which requires offline processing in order to provide results of value to the petroleum researcher. This paper provides illustrations of the techniques which have been utilized to provide either pictorial representations of CT images or quantitative interpretations of CT data. 11 refs., 13 figs.

38066 (AOSTRA–8808, pp. 12) **The use of chemical additives during steam stimulated recovery to improve reservoir and surface transportation of heavy oils.** Clark, P.D. (Univ. of Calgary, Calgary, AB, Canada); Clarke, R.A.; Lesage, K.L.; Hyne, J.B. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

Recovery of heavy oil by steam stimulation of the more deeply buried reservoirs has become an accepted practice. At the high temperatures (150-300^{0}C+) generated in the formation, it should be possible to devise additives that can bring about chemical as well as physical changes in the oil phase or minerals. Addition of carbon monoxide makes use of the water gas shift reaction to produce reactive hydrogen in situ, which can simplify the oil structure and reduce viscosity by hydrogenation of key functional groups. Added ferric ions catalyze key chemical reactions, resulting in similar changes that improve oil mobility. These additives also affect H_2S production. 11 refs., 4 figs., 4 tabs.

38067 (AOSTRA–8808, pp. 14) **The behaviour of various oil sands towards high temperature steams.** Clark, P.D. (Univ. of Calgary, Calgary, AB, Canada); Clarke, R.A.; Lesage, K.L.; Hyne, J.B. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

This paper describes a laboratory evaluation of the effect of steam on over 40 Canadian and Venezuelan heavy oil samples. Oil sands show great variability in their reactions with high temperature steam in terms of gases produced and changes in oil properties. Despite the fact that all of the heavy oils studied contained large quantities of bound sulfur (3-6 weight %), some samples liberated considerable quantities of H_2S while others liberated none. Structural changes occur in heavy oils as a result of steam treatment, such that changes in oil viscosity were observed. The majority of the samples studied showed small to moderate reductions in oil viscosity but some showed increases. For most oil sands, increases in steam treatment temperatures (200 to 300^{0}C) result in lower oil viscosities. This is likely due to C-C bond cleavage and hydrolysis of C-S-C links. Contact time between the steam and oil also influences oil viscosity but, in general, time effects are not as great as temperature effects. Steam treatment of heavy oil fractions underlined the variability of oil properties and showed that CO is a primary product of steam-oil interactions. Previous data have linked the release of CO to steam-organosulfur compound reactions. 11 refs., 2 figs., 7 tabs.

38068 (AOSTRA–8808, pp. 6) **Application of the IITRI/VENTECH electromagnetic stimulation process to Canadian heavy oil reservoirs.** Spencer, H.L. (Electromagnetic Oil Recovery Ltd., Calgary, AB, Canada); Bennett, K.A.; Bridges, J.E. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

This paper concerns an electromagnetic approach to thermal well stimulation. The process is achieved by designing the completion of the well in such a way that the production casing and tubing can act as an antenna powered from the surface. Electromagnetic fields are induced in the zones near the wellbore by the action of the antenna, and heating of the reservoir fluids occurs through a combination of ohmic and dielectric mechanisms. Multiple pay-zones can be heated simultaneously. Several successful field tests have been run in the U.S., Canada, and Brazil. This paper describes the results obtained by application of one version of the process in heavy oil wells in Canada. 5 figs., 1 tab.

38069 (AOSTRA–8808, pp. 10) **Hot water and caustic or carbon dioxide for the recovery of bitumen from Athabasca oil sands.** Nasr, T.N. (Alberta Research Council, Edmonton, AB, Canada); Nguyen, D.M.; McKay, A.S. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

Laboratory coreflood experiments were conducted on Athabasca oil sands, using hot water and caustic, or carbon dioxide. Production temperatures were maintained at 150^{0}C or lower and with a

production back-pressure of 500 psi. The objective of the experiments was to determine the conditions under which oil-in-water (O/W) emulsion could be produced in situ and to investigate the potential benefit of adding carbon dioxide to hot water to improve bitumen recovery. The results prove that when the pH of injected fluids is between 10.5 and 11.5, the O/W emulsion predominates. The emulsion is stable and has a viscosity much lower than that of the oil itself, due to the continuous water phase, and should be beneficial in the recovery of heavy oil and bitumen. When the produced fluids have a pH less than 9, the water-in-oil (W/O) emulsion predominates. The laboratory data indicate that even this type of emulsion behaves as an O/W in the core, but it is unstable and, when produced, the droplets quickly coalesce and immediately form the observed W/O emulsion. The hot water-carbon dioxide process not only provides the low viscosity, in situ, W/O emulsion but also produces a fluid that automatically separates most of the bitumen from the associated water. The addition of carbon dioxide to hot water at low temperatures proved to be more effective in improving bitumen recovery than that from hot water alone. Another beneficial effect is the ability to control the pressure gradient by varying the amount of free carbon dioxide in the injected stream. The hot water-CO_2 runs produced mostly W/O emulsion. The best recovery was achieved when the produced fluids temperature was at the relatively low temperature of 130^0C. 4 refs., 8 figs., 2 tabs.

38070 (CHOA–8711, pp. 22) **Thermal injection well testing.** Poon, D. (Alberta Oil Sands Technology and Research Authority, Edmonton, AB, Canada); McGee, B.; Gozde, S.; Best, D. Canadian Heavy Oil Association (Canada). 1987. (CONF-8709445–: 6. quarterly meeting of the Canadian Heavy Oil Association, Calgary, Canada, 22 Sep 1987;CE–02643). In *Reservoir description. Proceedings [of the] sixth quarterly meeting of the Canadian Heavy Oil Association.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $N/C.

A review is presented on the techniques of thermal well testing and the evaluation of the analysis methods using the test data obtained from thermal pilots in Alberta. Thermal well testing is the transient pressure analysis of wells used in a thermal recovery process such as steam stimulation, steam flood or in-situ combustion. Those pilots have been used in the testing of thermal in-situ recovery of bitumen from various oil sand deposits. During the operation of these pilots, many pressure falloff tests have been condusted. It was found that the pressure falloff test data were fairly accurate and generally consistent with the predictions of a composite reservoir model. The analysis results provided useful information reagarding the wellbore damage or stimulation during the injection history of the well. In addition, it was demonstrated that the pressure falloff tests could be used to monitor the combustion process by determining the volume, shape, thermal efficiency and fuel concentration of the burnt zone. These parameters are essential for estimating the energy requirement of the in-situ combustion process. Finally, the test results have been interpreted to demonstrate the shape of the steam zone and the effect of bottom water sand. With the experience gained from further field tests, it was felt that thermal well testing could become a useful tool for determining the reservoir characteristics and monitoring the thermal recovery processes. 10 refs., 16 figs.

38071 (CHOA–8805, pp. 24) **Options for upgrading heavy hydrocarbons in western Canada.** Yildirim, E. (Canadian Occidental Petroleum, Ltd, Canada). Canadian Heavy Oil Association (Canada). 1988. (CONF-8805308–: Quarterly meeting of the Canadian Heavy Oil Association, Calgary, Canada, 10 May 1988;CE–02644). In *Options for upgrading in western Canada. Proceedings [of the] quarterly meeting of the Canadian Heavy Oil Association.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $N/C.

This paper contains a brief review of alternatives for upgrading heavy oils and bitumen products from Alberta's oil sands. Economic and technical advantages and disadvantages of a number of options for heavy oil upgrading are discussed, including integration of mining and upgrading, activities regional upgrading facilities, upgrader integration with refineries, capacity additions to integrated plants, and partial upgrading on production fields followed by centralized hydrotreating. Also discussed are bitumen refineries and coprocessing of coal and heavy oil.

38072 (CHOA–8805, pp. 23) **Thermal treatment of heavy oils with the Taciuk processor for production of pumpable distillates and steam for reservoir stimulation.** Taciuk, W. (UMATAC Industrial Processes, Calgary, AB, Canada); Caple, N.R. Canadian Heavy Oil Association (Canada). 1988. (CONF-8805308–: Quarterly meeting of the Canadian Heavy Oil Association, Calgary, Canada, 10 May 1988;CE–02644). In *Options for upgrading in western Canada. Proceedings [of the] quarterly meeting of the Canadian Heavy Oil Association.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $N/C.

The Taciuk Processor, utilizes a subatmospheric pressure, horizontal rotating assembly to thermally crack heavy oils and bitumens. The light oil product characteristics and product yields are very similar to those obtained by fluid coking. This paper provides a summary of the process development history including key yield and quality information obtained from pilot plant testing of various oil sands and oil shale feeds. It then goes on to describe results of test work carried out on heavy oils from the Lloydminster area and summarizes the parameters for a 5,000 bbl/d field-located integrated processor plant which produces a pumpable light oil distillate and high pressure steam at an approximate ration of 1.3 bbl of steam per barrel of feed oil. 7 figs., 4 tabs.

38073 (DOE/MC/11090–2711) **Production of bitumen-derived hydrocarbon liquids from Utah's tar sands: Final report.** Oblad, A.G.; Hanson, F.V. Utah Univ., Salt Lake City, UT (USA). Dept. of Fuels Engineering. Jul 1988. 164p. Sponsored by DOE Fossil Energy. DOE Contract FG21-87MC11090. Order Number DE89000996/JAW. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

In previous work done on Utah's tar sands, it had been shown that the fluidized-bed pyrolysis of the sands to produce a bitumen-derived hydrocarbon liquid was feasible. The research and development work conducted in the small-scale equipment utilized as feed a number of samples from the various tar sand deposits of Utah elsewhere. The results from these studies in yields and quality of products and the operating experience gained strongly suggested that larger scale operation was in order to advance this technology. Accordingly, funding was obtained from the State of Utah through Mineral Leasing Funds administered by the College of Mines and Earth Sciences of the University of Utah to design and build a 4-1/2 inch diameter fluidized-bed pilot plant reactor with the necessary feeding and recovery equipment. This report covers the calibration and testing studies carried out on this equipment. The tests conducted with the Circle Cliffs tar sand ore gave good results. The equipment was found to operate as expected with this lean tar sand (less than 5% bitumen saturation). The hydrocarbon liquid yield with the Circle Cliffs tar sand was found to be greater in the pilot plant than it was in the small unit at comparable conditions. Following this work, the program called for an extensive run to be carried out on tar sands obtained from a large representative tar sand deposit to produce barrel quantities of liquid product. 10 refs., 45 figs., 11 tabs.

38074 (WCWWA–8710, pp. 139-149) **Shell Peace River source water treatment facility.** Page, G. (Shell Projects, Inc., Calgary, AB, Canada). Western Canada Water and Wastewater Association, Calgary, AB (Canada). 1987. (CONF-8710478–: 39. annual convention of the Western Canada Water and Wastewater Association, Saskatoon, Canada, 21-23 Oct 1987;CE–02659). In *Proceedings of the 39th annual convention of the Western Canada Water and Wastewater Association.* Available from Western Canada Water and Wastewater Association, P.O. Box 6168, Postal Station A, Calgary, AB, Canada T2H 2L4; $20.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report describes the design of the Shell Canada Peace River Expansion Project I source water treatment facility which supplys water for steam generation to their in-situ pilot project for recovery of bitumen. The Peace River has a high level of suspended solids. The initial processing stage removes floating debris and returns fish to the river. Suspended solids are coagulated and flocculated in a

solids contact clarifier. This is followed by gravity filtration through sand. In the final step all oxygen is removed from the water in a vacuum deaerator. Treated water is supplied to the central plant via pipeline. 5 figs., 2 tabs.

0405 Properties and Composition

Refer also to citation(s) 37869, 37918, 38012, 38015, 38016, 38019, 38036, 38044, 38046, 38048, 38061, 38064

38075 (AOSTRA–1988, pp. 10) **Compaction characteristics of Athabasca oil sand and its suitability as a backfill material.** Cameron, R. (Syncrude Canada Ltd., Fort McMurray, AB, Canada); Lord, E.R.F. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

Syncrude Canada, in its operation of an open-pit oil sand mine in northern Alberta, utilizes significant quantities of backfill material to contruct ramps, to replace unstable areas of the mine highwall for safe heavy equipment operation, and to construct foundations for major structures such as reinforced-earth walls. For about half the year the mean daily temperature is below zero, which limits the type of backfill material and when it can be used. A shortage of readily available suitable backfill material provided the impetus to assess the possibility of utilizing oil sand. The compaction characteristics of oil sand at different bitumen contents were established in the laboratory. An important aspect of the work was the consideration of both the water and bitumen as part of the fluid phase. The validity of the laboratory results were demonstrated in the field. Compaction test procedures and results are provided for non-frozen, partially-frozen, and frozen oil sand. Operational guidelines are presented for the use of oil sand as a backfill throughout the year. 7 refs., 11 figs.

38076 (AOSTRA–1988, pp. 10) **Characterization parameters for Alberta crudes and bitumens.** Fu, C.-T. (Alberta Research Council, Edmonton, AB, Canada); Bird, G.; Hsi, C. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

Thermodynamic properties of bitumen-containing systems are particularly important to process engineers in the study and design of bitumen recovery from oil sands, the development of numerical simulations, and the application of various flooding processes for enhanced oil recovery. In spite of their importance, only limited reliable data for these systems are available. Therefore, the required properties are usually calculated by an equation of state. As characterization parameters of bitumens and heavy crudes are essential input parameters during vapor-liquid equilibrium calculations by means of an equation of state, one of the major objectives of this study was to determine these parameters for Alberta heavy crudes and bitumens from selected estimation methods. 37 estimation methods were selected from a total of 125 different correlations available in the literature. These were then tested against 426 readily measurable heavy hydrocarbons, most having molecular weight greater than 72. Characterization parameters of several Alberta bitumens and heavy crudes were determined on the basis of preliminary tested results from the six best methods. 24 refs., 8 tabs.

38077 (AOSTRA–1988, pp. 14) **Vapour-liquid and liquid-liquid equilibria in the CO_2-bitumen-brine system.** Nighswander, J.A. (Univ. of Calgary, AB, Canada); Kalogerakis, N.; Mehrotra, A.K. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

Vapor-liquid and liquid-liquid equilibrium properties of CO_2-bitumen-brine mixtures at reservoir conditions are important for the study of bitumen recovery. In this paper, a new set of experimental data for the CO_2-brine system is presented. The data are compared with the predictions from two existing thermodynamic models. Also discussed are preliminary data on the CO_2-bitumen vapor-liquid system and the subsaturation distribution of carbon dioxide between the bitumen and brine phases. The key variables in this study were: pressure (up to 10 megapascals), temperature (80-200^{0}C), and brine composition (0 and 1 mass percent NaCl). Also described is a new experimental apparatus that has been constructed to operate under the above conditions. The apparatus employs a novel technique for liquid sampling that eliminates many of the problems associated with sampling in experiments. It provides reproducible results. 15 refs., 9 figs., 3 tabs.

38078 (AOSTRA–1988, pp. 18) **A generalized viscosity correlation for Alberta heavy oils and bitumens.** Puttagunta, V.R. (Lakehead Univ., Thunder Bay, ON, Canada); Singh, B.; Cooper, E. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

Prediction of viscosity of bitumens and heavy oils as a function of temperature and pressure is essential for estimating oil recoveries, development of in-situ processes, numerical simulation, and upgrading operations. It is well known that the viscosity of naturally occurring Alberta heavy oils and bitumens varies widely from deposit to deposit. The extensive viscosity data and correlations available for these oil are specific to the oils used in the particular experimental study. This paper presents a generalized correlation suitable for predicting viscosity of Alberta heavy oils and bitumens over a wide range of temperatures and pressures. This correlation has a unique feature in that to predict viscosity of any oil it only requires a single viscosity measurement at 30^{0}C. The correlation yields calculated viscosities with average deviation of less than 6% over a range of temperatures and pressures relevant to in-situ recovery processes. 14 refs., 8 figs., 8 tabs.

38079 (AOSTRA–1988, pp. 10) **Pressure and temperature dependence of the interfacial tensions of fireflood and steamflood bitumen/water systems.** DeFilippis, F. (Univ. of Toronto, Toronto, ON, Canada); Budziak, C.; Cheng, P.; Neumann, A.W.; Potoczny, Z.M. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

Pressure and temperature dependence of fireflood and steamflood bitumen/water systems was determined using Axisymmetric Drop Shape Analysis (ADSA). ADSA is a computational procedure that calculates surface and interfacial tensions from the shape of pendant and sessile drops. The strategy employed is to construct an objective function for a Laplacian curve that is minimized using the method of incremental loading in conjunction with a Newton Raphson iterative scheme. Apart from local gravity and the densities of liquid and fluid phases the only input information required is an arbitrary array of drop profile coordinates. A pendant drop of the bitumen was suspended in water and transilluminated using a fibre optic light source. The pressure and temperature of the system was then set to the desired value and the system allowed to equilibriate. A video image of the drop at the specific temperature and pressure condition was obtained; using an edge detection scheme, profile coordinates were determined by a newly developed automatic method of digitization. The interfacial tension was subsequently determined by ADSA. The interfacial tension for both the fireflood and steamflood bitumen decreased with time. Both samples also showed an

initial increase and then a subsequent decrease in interfacial tension with increasing temperature. The dependence of the interfacial tensions of the bitumen/water systems on pressure was found to be minimal. 15 refs., 13 figs.

38080 (AOSTRA–1988, pp. 24) **Recent advances in the chemistry of Alberta bitumens and heavy oils.** Strausz, O.P. (Univ. of Alberta, Edmonton, AB, Canada). Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

The heavy oils, oil sand and carbonate bitumens of Alberta are of similar maturity and origin. They have analogous biomarker compositions and concentration distributions with relatively minor variations owing to differences in the history of reservoir conditions. They are all rich in biomarkers, such as the isomeric homologous series of cyclic terpenoid sulfides and sulfoxides, the cyclic terpenoid carboxylic acids and their parent hydrocarbons, detected for the first time in Alberta bitumens and later shown to be ubiquitous components of petroleum. The sulfides and sulfoxides make up 4-14% of the maltene. These sulfides readily react with air to form sulfoxides which are highly polar. Thus oxidation, which also converts the sulfur in pyrite and other minerals to sulfate, can affect the processability of the bitumen. The oil sands contain varying amounts of non-bituminous organic materials like humic and fulvic acids and humins which, in low grade ores, may amount to 25% of the bitumen, also influencing processability. The bitumens contain only trace amounts of n-alkanes yet the asphaltene and the heavy ends of the maltene contain copious quantities of n-alkyl bridges. These aliphatic portions also contain n-alkane-derived sulfides and thiophenes. On thermolysis, the chains, bridges and sulfide linkages can be readily cleaved, having an enormous effect on the upgrading of the bitumen. New approaches developed for the elucidation of the structure of asphaltene are described. 38 refs., 17 figs., 4 tabs.

38081 (AOSTRA–1988, pp. 18) **Biomarker geochemistry of cretaceous oil sand/heavy oils and paleozoic carbonate trend bitumens, Western Canada Basin.** Brooks, P.W. (Geological Survey of Canada, Calgary, AB, Canada); Fowler, M.G.; MacQueen, R.W. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

The immense bitumen resources of the Western Canada Basin are biodegraded, and major questions remain about their makeup and origin. Biomarkers or geochemical fossils occur in source rocks and petroleum, permitting oil-oil and oil-source correlations. A 24 sample suite of carbonate trend bitumens, from five different Paleozoic formations in 11 boreholes, is compared with data obtained earlier from a 40 sample Cretaceous oil sand suite. The carbonate trend samples show an extreme level of biodegradation, and the apparent presence of two oil families, one containing and one lacking the distinctive and uncommon biomarkers 28,30-bisnorhopanes, believed to be source-specific. Gross compositions vary considerably but fall within the Cretaceous sample range. Gross composition does not reflect biodegradation degree as otherwise indicated by biomarkers. The apparent formation succession from most to least biodegraded is Grosmont>Nisku>>Debolt, Shunda, Upper Ireton; other than this, there is no clear geographic, stratigraphic or depth pattern to diodegradation. $C_{27,28,29}$ diasterane ratios form a tight cluster, comparing closely with Cretaceous samples and suggesting a common origin, as do several other biomarker ratios. 25 refs., 6 figs., 5 tabs.

38082 (AOSTRA–8808, pp. 22) **Effect of temperature and flow rate on viscous oil-water relative permeability of sand.** Maini, B.B. (Petroleum Recovery Inst., Calgary, AB, Canada); Coskuner, G. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

A review of recent literature shows that the effect of temperature on the relative permeability of oil and water varies widely among different systems, and it is unlikely that the direction and magnitude of observed changes can be generalized. The influence of possible experimental artifacts is discussed in this paper. Measurements of relative permeability in a silica sand-viscous mineral oil-deionized water system at temperatures ranging from 23 to 200^{0}C are presented. It is shown that the measurements of relative permeability by unsteady state technique are flow rate sensitive over a wide range of flow rates. Unlike the conventional oil systems where the flow rate dependence disappears at higher flow rates as the capillary end effects are overcome, in viscous oil systems the onset of viscous fingering even before the capillary end effects are overcome can make the relative permeability measurements much more flow rate dependent. Some of the conflicting results reported in the literature appear to be caused by an arbitrary selection of flow rates for measurements at different temperatures. Finally, a comparison of steady-state and unsteady-state measurements at two different temperatures in the same system is presented. 17 refs., 15 figs., 6 tabs.

38083 (AOSTRA–8808, pp. 10) **Characterization of pore images in a heavy oil reservoir and its applications.** Yuan, L.P. (Alberta Research Council, Edmonton, AB, Canada); Kramers, J.W. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

Image analysis is used to quantify thin section pore geometry and to study the pore systems of a heavy oil reservoir, the Provost Upper Mannville B Pool of east central Alberta. Thin section views of reservoir sands are digitized and segmented into binary pore images. An erosion-dilation process is applied to these binary images. The result is a pore size distribution. Through a multivariate unmixing algorithm, end member pore types are recognized and the pore systems are then treated as mixtures of these end members. Relations between geological facies, pore systems, and permeability of the reservoir sands have been studied. By examining the fractions of each end member pore type, four pore systems are identified and found to be strongly correlated with geological facies. This relationship helps to explain the formation of the different pore systems in the reservoir. Pore size also shows a significant correlation with measured permeability and can be used to predict permeabilities of other samples that do not have permeability measurements. The results of this study indicate that by using petrographic image analysis of thin section samples, geological facies information can be effectively used in characterizing such reservoir properties as permeability. 19 refs., 5 figs., 1 tab.

38084 (AOSTRA–8808, pp. 5) **Chemistry and resources of heavy oil and natural bitumen deposits.** Hosterman, J.W. (U.S. Geological Survey, USA); Meyer, R.F. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

Supplies of conventional crude oil are diminishing; therefore it is important to understand the reservoir characteristics of unconventional oil deposits. Reservoirs of unconventional deposits contain oil heavier than 20^0 American Petroleum Institute gravity and natural bitumens (tar sands and oil sands) more viscous than 100 poises.

The U.S. Geological Survey is undertaking a program to analyze the reservoir rock mineralogy and hydrocarbon chemistry of samples from the major heavy oil and natural bitumen deposits of the world. 25 samples from seven heavy oil and natural bitumen deposits in the United States and three deposits outside the United States form the basis of the initial study. This report gives preliminary results on the mineralogy of the reservoir rock, and on clay and bitumen content from the 11 deposits. Also included are the organic and inorganic chemical analyses of the Trapper Canyon tar deposit in Wyoming. Each sample was treated with benzene to extract the hydrocarbons and leave the sediment as a residue. Chemical analyses were made of the hydrocarbons and the sediment residue and of the untreated whole sample. Mineralogical analyses were made on the sediment and the clay fraction of the sediment. The amount of bitumen in the reservoir rock appears to be somewhat dependent on the lithology. Limestones and shales do not contain as much bitumen as sandstones. From the samples that were collected in the United States, bitumen in limestone averaged 5.8 wt%; in the shale, the average was 8.4 wt%; in sandstone, the average was 11.6 but ranged from 7.0 to 18.4 wt%. Preliminary data indicate that the type of clay minerals may not have a serious effect on the amount of bitumen, but the amount of clay may have a serious effect on the amount of bitumen. 18 refs., 1 tab.

39085 (AOSTRA–8808, pp. 7) **Viscosity dependence of the diffusion coefficient of carbon dixide in bitumen.** Schmidt, T. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

This paper investigates the diffusivity-viscosity relationship of viscous fluids using bitumen/carbon dioxide system as a model. The theoretical foundations are investigated and a reconciliation between the activation-energy theories and the free-volume theories of diffusion are achieved. It is demonstrated that Einstein's relation should not be indiscriminately extended to all liquid systems. Diffusion data are correlated with viscosity data using a new approach. 26 refs., 1 fig., 1 tab.

0406 Direct Uses and By-products

38086 (AOSTRA–1988, pp. 5) **Fluidized bed combustion of petroleum coke coagglomerated with lime or limestone.** Majid, A. (National Research Council of Canada, Ottawa, ON, Canada); Sparks, B.D.; Manner, C.A. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

The relatively high sulfur content of coke produced during the upgrading of Athabasca bitumen makes it environmentally unsuitable as a fuel. Using heavy oil or bitumen as a binder these cokes were coagglomerated with limestone in an attempt to reduce emissions during combustion. By providing an environment where there is intimate contact between fuel and sorbent it was hoped that greater utilization of the sorbet could be achieved, compared to the systems where the sorbent is added separately to the combustion bed. Cokes from both Suncor and Syncrude operations were used in this investigation. The combustion tests on coke-sorbent agglomerates were carried out in a bench scale fluidized bed apparatus at 850^{0}C. Test results indicated sulfur capture of over 60% for Syncrude coke and over 50% for Suncor coke with a calcium to sulfur molar ratio of 1:1. The presence of moisture did not appear to have any significant effect on sulfur capture. Other variables investigated included the role of binder, the effect of coke size and calcium to sulfur mole ratio. 10 refs., 4 tabs.

38087 (AOSTRA–8808, pp. 17) **Utilization of Buton Island rock asphalt in road pavements.** Corne, C.P. (Asbuton Specifications Development Project, Indonesia); Soehartono, I. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02658). In *UNITAR/UNDP, 4th international conference on heavy crude and tar sands, vol. 2.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

At present, Indonesia imports large quantities of bitumen to meet the demand for road works. These imports could be reduced or totally eliminated if the large reserves of Asbuton, a bitumen-impregnated limestone found on Buton Island, could be developed to produce either a road grade bitumen or a refined Asbuton product suitable for direct inclusion in road asphalt mixes. This paper briefly outlines some of the technical and economic difficulties associated with the development of Asbuton for use in asphalt pavements and describes both recent progress and planned future activities. It describes the main mechanisms affecting the properties and performance of Asbuton asphalt mixes, based on the results of laboratory and field studies spanning the past five years. The inclusion of raw, unrefined Asbuton in an asphalt mix imparts a strong time-dependent aspect to the mix properties and performance, and the prediction and control of this time-dependent behavior is the key technical problem to be addressed in designing and specifying LASBUTAG mixes. With suitable modifications for this aspect, including the use of two sets of specified Marshall test criteria for compaction and mix air voids (appropriate to both the short- and long-term mix properties), the generalized asphalt technology that was developed for high-durability hot-mix asphalts, and which is currently being used on many road projects in Indonesia, provides the required tool for handling the design of road asphalts incorporating Asbuton. 10 refs., 11 figs.

0408 Marketing and Economics

Refer also to citation(s) 38037, 38048, 38049, 38094

38088 (AOSTRA–8808, pp. 14) **Economics of Alberta's oil sands development.** Precht, P. (Alberta Dept. of Energy, Edmonton, AB, Canada); Sullivan, K.; Kahler, P. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

The enormity of Alberta's oil sands deposits is an important component in the security of Canada's future energy needs. However, the oil sands are clearly more costly relative to conventional oil development. This paper discusses the nature, magnitude, and economic importance of the development of Alberta's oil sands. It provides a chronology of developments, a brief description of proposed and completed projects, and a discussion of the economic and political context in which development has proceeded. It concludes with a look at the future of the oil sands in the Alberta economy: the types of projects currently under discussion, the improved economic environment from that of the 70's and early 80's, and the importance of the oil sands in Alberta's and Canada's energy future. 12 refs., 3 figs.

38089 (CANWEC–1989, pp. 86-88) **The outlook for Canadian demand for bitumen and synthetic crudes produced from oil snads.** Taylor, D.J. (Shell Canada Products, Ltd.). Canadian National Committee, World Energy Conference, Ottawa, ON (Canada). [1989]. (CONF-8811238–: 11. Canadian national energy forum, Calgary, Canada, 21-22 Nov 1988;CE–02686). In *Energy in Canada. The potential, the markets and the money.* Available from Canadian National Committee World Energy Conference, Suite 305, 130 Albert Street, Ottawa, Ont., Canada K1P 5G4; $30.00 CAN.

This paper discusses the outlook in Canadian demand for western Canada conventional light and medium crude. The paper begins

with an assessment of the 1988 disposition of these products, continuing to an imbalance in the 1990s, leading to increasing columes for Ontario. The paper also deals such other concerns as environmental protection, customer requirements, the crude oil supply, pricing, and refining capital. It is concluded that a strong and strengthening demand for Canadian light and medium crudes will remain.

38090 (GAO/RCED–87-126) **Alternative fuels.** General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. 1988. 69p. Available from US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Department of Energy awarded the Union Oil Company $400 million in price guarantees for synthetic crude oil produced by Parachute Creek shale oil project in Colorado. In 1985, Synthetic Fuels Corporation awarded an additional $500 million in price and loan guarantees to Union to modify the project's technology with a fluidized bed combustor. In December 1985, the Congress abolished SFC and transferred responsibility for the guarantees to the Treasury. GAO believes that because of the uncertainty of the project's economic and technical viability, it would not be in the government's best interest to expend an additional $500 million in financial assistance to install the combustor. If Union elects to proceed with the combustor, GAO recommends that Treasury use the analysis in this report to critically evaluate Union's proposal and explore the government's options for minimizing additional outlays on the project.

0409 Waste Research and Management

38091 (AOSTRA–1988, pp. 6) **Fractal geometry and the setting of oil sand tailings sludge.** Crickmore, P.J. (Univ. of Alberta, Edmonton, AB, Canada); Schuttle, R.; Causgrove, J. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

In an attempt to model the settling behaviour of oil sand sludges it is demonstrated that a fruitful approach is to regard sludge as a material which passes through a continuum of structures with age and that the rate-determining process in sludge-settling is the rearrangement of small particles within larger aggregates leading to solids which can pack more and more densely as the rearrangement process continues. Two sets of experiments were conducted. One consisted of monitoring the interface between free water and sludge for oil sands tailings sludge left to settle in glass cylinders of various diameters. The second set monitored changes in height of the sludge layer for oil sands tailings sludge in polycarbonate bottles after centrifugation. It is shown that the slow settling of oil sand tailings sludge is due to a slow rearrangement of particles in the sludge. Changes in sludge structures (and the corresponding changes in sludge density) are well-modelled by a fractal dimension, which increases with time. This model leads to a three parameter equation which provides an excellent fit to sludge settling data. The Elovich equation (also a three parameter model) provides good fits to sludge settling data, provided that the region of interest is confined to a time range of two orders of magnitude or less. 8 refs., 4 figs.

38092 (CHOA–8709, pp. 11) **Slop oil treating at Shell Canada's Peace River complex.** Shaw, W.A. (Aqua-Chem, Inc., Milwaukee, WI, USA); Hoffman, E.R.; Padula, M. Canadian Heavy Oil Association (Canada). 1987. (CONF-8709445–: 6. quarterly meeting of the Canadian Heavy Oil Association, Calgary, Canada, 22 Sep 1987;CE–02642). In *Surface facilities optimization program. Proceedings [of the] fifth quarterly meeting of the Canadian Heavy Oil Association.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $N/C.

Shell's existing oil sands plant at Peace River operates on a pressure cycle steam drive production process. Significant quantities of oil/water emulsions are produced as interfacial rag layers in gravity separation equipment. To date, evaporation is considered to be the most reliable and cost effective method for breaking these slop oil emulsions. An evaporative slop oil treater was designed and installed at the Peace River site. The design was pilot tested in February 1986 and start-up of the production unit was completed in May 1987. Forced circulation of the slop oil under pressure is employed in the treater to prevent fouling and plugging of the heat exchanger. Fast response to changing water content in the incoming slop oil feed and dewatering of the slop oil to less than 0.5% water by weight from feed stocks containing up to 40% water is achieved. This paper discusses the features of the design and some operating results. The treater unit has shown the ability to dewater very high water cut (up to 80%) without any tendency to foul or plug the heat transfer surfaces, even with high solids loading in the slop oil. 4 figs., 1 tab.

0410 Environmental Aspects

Refer also to citation(s) 38035, 38064

38093 (AOSTRA–8808, pp. 14) **Venezuelan exprience in simulation of compaction and subsidence associated to oil production.** Espinoza, C. (PDVSA, Caracas, Venezuela); Mirabal, M. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

Previous studies have shown the importance of compaction as the main production mechanism in heavy oil reservoirs in western Venezuela. The presence of compaction, and its effect on the production of oil from reservoirs in the Bolivar Coast, have been observed. Due to the unconsolidated nature of the sands in the Orinoco Heavy Oil Belt field, it is also expected that compaction will play an important role in the production of oil from this area. On the other hand, compaction gives rise to surface subsidence, which has to be quantified in order to control the negative effects thay may occur. In view of this, it is necessary to have adequate tools to model the effects of oil production on compaction, and on surface subsidence. This work presents the different simulation tools developed by the Venezuelan oil industry to model compaction and subsidence. The models range from simple algorithms to comlex models based on the numerical solution of different equations. The methods considered include: statistical/analytical methods (history match based on production, observed subsidence, and extrapolations), semianalytical methods (solution of single phase flow in a compacting porous medium), improved numerical reservoir simulation models, and numerical models that solve rock mechanical equations (stress-strain relations) with finite element or boundary element methods. Some results of the application of the models to areas of the Bolivar Coast in western Venezuela as well as preliminary results for simulations of the Orinoco Oil Belt field are presented. The applicability of these models to specific problems is discussed. 16 refs., 9 figs.

0420 Regulations

38094 (AOSTRA–8808, pp. 9) **Fiscal treatment of oil sands development in Alberta.** Precht, P. (Alberta Dept. of Energy, Edmonton, AB, Canada). Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02599). In *UNITAR/UNDP 4th international conference on heavy crude and tar sands, vol. 3.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $150.00 CAN.

This paper presents chronologically and in considerable detail the fiscal regimes for all the major oil sands projects, upgraders, and in situ bitumen projects in Alberta. This chronology demonstrates the evolution of the current fiscal regimes and how they relate to the provincial government's non-renewable resources development

objectives. In particular, the royalty structures that apply to the following major projects are considered: Suncor Oil Sands Plant, Syncrude Oil Sands Plant, Alsands Oil Sands Venture, Husky Bi-Provincial Upgrader, and in situ bitumen production operations. There has been a very clear evolution in the royalty treatment that has been applied to oil sands development in Alberta. The profit-sensitive royalty regimes now in place are established to provide a stable and responsive anchoring during the often volatile economic climate experienced by the oil sands industry.

05 NUCLEAR FUELS

Refer also to citation(s) 38863

38095 (INIS-mf–11440, pp. 51) **Method for nuclear fuel dimensional analysis.** Craciunescu, T. (Institutul de Reactori Nucleari Energetici, Pitesti (Romania)); Alexa, A.; Pirvan, M.; Stamatescu, L. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

A method in which dimensional measurements are used for ovality and bow determination. This provides a simple and accurate way to correlate the diameter measurements. (authors).

38096 (INIS-mf–11440, pp. 746-747) **Determination of activity distribution in the cross section of the irradiated fuel rods by a maximum entropy emission computed tomography method.** Alexa, A. (Institutul de Reactori Nucleari Energetici, Pitesti (Romania)); Craciunescu, T.; Pirvan, M.; Stamatescu, L. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

In order to improve the fuel burn-up calculations by gamma scanning, the activity distribution is reconstructed using parallel beam aquisition geometry and a maximum entropy method. (authors).

0501 Reserves, Exploration, and Mining

Refer also to citation(s) 38116, 38207, 38225, 38227, 38228, 39325, 39554, 39560, 39574

0504 Feed Processing

Refer also to citation(s) 38200

0505 Uranium Enrichment

Refer also to citation(s) 38239

38097 (K/QT–249/P) **A dynamic flow-weighted pore size distribution.** Fain, D.E. Oak Ridge Gaseous Diffusion Plant, TN (USA). 1989. 8p. Sponsored by DOE Nuclear Energy. DOE Contract AC05-84OR21400. (CONF-8907102–1: First international conference on inorganic membranes, Montpellier (France), 3-6 Jul 1989). Order Number DE89014522/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper highlights the theory and operation of a method for measuring flow-weighted pore size distributions. This method is accomplished by measuring the flow of a mixture of an inert and a condensable gas under specific conditions. The partial pressure of the condensable gas is varied to produce capillary condensation, which plugs the pores of the membrane. At each pressure, the flow of the gas mixture is measured. The change in flow rate between pressures is then related to the pore size through the Kelvin equation for capillary condensation. Data giving accurately measured pore size distribution are extremely important when one attempts to understand the function of a porous material. Pore size distributions are usually determined by measuring the change in volume of a material deposited in the porous material under varying conditions that relate to pore size. A flow-weighted pore size distribution should provide information more meaningful for understanding the performance of a membrane. Pore size distributions measured on several commercially available membranes are shown. 2 refs., 5 figs.

0507 Fuels Production and Properties

Refer also to citation(s) 38102, 38116, 38242, 38795, 38903, 39057, 39058, 39476, 39506, 39507, 39513, 39514, 39515, 39575, 39578, 39579, 39588, 39589, 39590, 39592, 39593, 39594

38098 (DP-MS–89-28) **Measurement of impurities in plutonium metal by rapid ion exchange/direct current argon plasma spectrometry.** Maxwell, S.L. III; Coleman, J.T. Westinghouse Savannah River Co., Aiken, SC (USA). 1989. 7p. Sponsored by DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-890736–36: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, FL, USA, 9-12 Jul 1989). Order Number DE89014140/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A rapid ion exchange/direct current argon plasma (DCAP) spectrometry method is now being applied at the Savannah River Site to provide faster, more reliable assay of key metallic impurities in plutonium metal. These measurements are essential for nuclear materials accountability and enhanced process control. Impurity assays must be performed to ensure that plutonium product specifications are met and to determine the 100% – impurities plutonium assay used in shipper/receiver calculations. Separation of impurities from plutonium metal is required prior to measurement by spectral techniques since the complex emission spectra of plutonium interferes with the impurity emission lines. A modified commercial vacuum system is used to perform the ion exchange separation in a glovebox. Since column flow rates are 10–15 times that of conventional ion exchange, purification time is relatively short. Separation efficiency is maintained by using small particle resin. The DCAP method is faster and provides much better accuracy and precision than the previously used carrier distillation dc arc spectrographic technique. The DCAP instrument has a much greater linear dynamic range than dc arc, does not require plutonium matrix standards for instrument calibration, and requires much less space than a dc arc spectrograph. Sixteen key metallic impurities are routinely measured using the ion exchange/DCAP spectrometry method. 11 refs., 6 figs., 1 tab.

38099 (GEH–26434-200) **Catalog of Hanford buildings and facilities, 200 Areas: A report by the AEC-GE Study Group for the Economic Development of Richland.** Hanford Works, Richland, WA (USA). Apr 1964. 135p. Sponsored by DOE Nuclear Energy. DOE Contract AC06-76RL01830. Order Number DE89015057/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

A description of the buildings at Hanford is provided in this report. (CBS)

38100 (RFP–4187) **Molten salt bath heating of uranium and its alloys.** Jackson, R.J. Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant. 10 May 1989. 48p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP03533. Order Number DE89014387/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

In the fabrication of uranium and its alloys, the workpiece is commonly preheated and postheated in a molten salt bath. In this report, past and present uranium salt bath technology is reviewed and critiqued. This critical review points out two distinct fruitful development areas: (1) need for a salt for warm working of uranium and (2) need for a hot working salt that will reduce the hydrogen content of the uranium workpiece. This report recommends that a nitrate salt be developed for warm working of uranium; it also recommends that a chloride-containing salt with a relative low melting point and capability to outgas uranium be developed for hot alpha-phase working and recrystallization of uranium. In selecting new heat-treating salts, two important considerations are: (1) the corrosive nature of the salt with the workpiece and (2) the corrosive nature of the salt with its container and workpiece carrier. These subjects are discussed as well as the ability of the new salt to be washed easily from the workpiece. 45 refs., 13 figs., 31 tabs.

0508 Spent Fuels Reprocessing

Refer also to citation(s) 38098, 38846, 38932

38101 (INIS-mf–11471, pp. 2) **Behavior of Pu in reprocessing of irradiated nuclear fuel from process solutions of the production of fission Mo.** Hladik, O. (Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic)); Bernhard, G.; Boessert, W.; Grahnert, T. Chemische Gesellschaft der DDR, Berlin (German Democratic Republic); Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic). 1988. (In German). (CONF-8811239–: Colloquium on on separation processes in radiochemical practice, Dresden, German Democratic Republic, 8 Nov 1988). In *Abstracts of the colloquium 'separation processes in radiochemical practice'.* Order Number DE89630813/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

FISSION PRODUCTS/plutonium; SPENT FUELS/reprocessing; PLUTONIUM; MOLYBDENUM ISOTOPES; PLUTONIUM ISOTOPES; SOLVENT EXTRACTION; REPROCESSING

38102 (ORNL/FTR–3314) **[Analytical chemistry for IAEA safeguards, Seibersdorf and Vienna, Austria, May 29–June 14, 1989]: Foreign trip report.** Smith, D.H. Oak Ridge National Lab., TN (USA). 5 Jul 1989. 19p. Sponsored by DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89014874/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The international safeguards program badly needs an on-site inspection device capable of providing the isotopic compositions of uranium and plutonium; this is especially important for assaying spent fuel solutions at reprocessing plants. An agreement between the IAEA and the Japanese reprocessing plant at Tokai has led to the installation of a Finnigan-MAT THQ mass spectrometer at the Tokai pollution facility (PFPF). It will be shared by the two organizations. The first scheduled use for the IAEA begins in August, 1989, and it was thus necessary to have a trained corps of inspectors available at that time. I assisted in preparation of the training course and in teaching its first week. Four inspectors received training. 4 refs.

0509 Transport and Storage

Refer also to citation(s) 38229, 38230, 38231, 38232, 38926

38103 (BNL-NUREG–42667) **Design and analysis of free-standing spent fuel racks in nuclear power plants: An overview.** Ashar, H.; DeGrassi, G. Brookhaven National Lab., Upton, NY (USA). 1989. 7p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC02-76CH00016. (CONF-890855–43: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA, USA, 14-18 Aug 1989). Order Number DE89012667/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

With the prohibition on reprocessing of spent fuel in the late 1970's the pools which were supposed to be short term storage became quasi-permanent storage spaces for spent fuel. Recognizing a need to provide permanent storage facilities for such nuclear wastes, the US Congress enacted a law cited as the Nuclear Waste Policy Act of 1982. The Act, in essence, required the Department of Energy to find ways for long term storage of high level waste. However, it also is required the owners of nuclear power plants to provide for interim storage of their spent fuel. The permanent government owned repositories are not scheduled to be operational until the year 2005. In order to accommodate the increasing inventory of spent fuel, the US utilities started looking for various means to store spent fuel at the reactor sites. One of the most economical ways to accommodate more spent fuel is to arrange storage locations as closely as possible at the same time making sure that the fuel remains subcritical and that there are adequate means to cope with the heat load. The free standing high density rack configuration is an outcome of efforts to accommodate to more fuel in the limited space. 3 refs., 3 figs.

38104 (CEA-DAS–554) **Approach of toxic and radiological risk equivalence in UF_6 transport.** Ringot, C.; Hamard, J. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. Jan 1989. 17p. (In French). (CONF-880558–: Uranium hexafluoride–safe handling, processing, and transporting conference, Oak Ridge, TN, USA, 24-26 May 1988). Order Number DE89792018/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

After a brief description of the present situation concerning the safety of the transport of UF6 and the new regulation project which is being developed under the behalf of IAEA, the equivalence of radioactive and chemical risks is considered for UF6 transport regulations. The concept of low specific activity appearing misfitting to toxic gas, it is proposed a quantity limit of material, T_2 (equivalent to A_2 for radioactive materials), for packagings which do not resist to accidental conditions, (9 m drop, 800^{0}C, 30 minutes fire environment). It is proposed that this limit is chosen as the release rate which is acceptable after the IAEA tests for packages having a capacity higher than T_2 kilograms. The fire being considered as the most severe situation for the toxic risk, different possible scenarios are described. This approach of risk equivalence leads to impose that the packaging resists a 800^{0}C - 30 minutes fire and that in this condition the release is less than T_2. The problem of the behaviour of the shell and the openings (in particular the valve) is raised in this context.

38105 (EPRI-NP–6409) **Handling of multiassembly sealed baskets between reactor storage and a remote handling facility: Final report.** Massey, J.V.; Kessler, J.H.; McSherry, A.J. Electric Power Research Inst., Palo Alto, CA (USA); Sierra Nuclear Corp., Los Gatos, CA (USA). c Jun 1989. 120p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The storage of multiple fuel assemblies in sealed (welded) dry storage baskets is gaining increasing use to augment at-reactor fuel storage capacity. Since this increasing use will place a significant number of such baskets on reactor sites, some initial downstream planning for their future handling scenarios for retrieving multi-assembly sealed baskets (MSBs) from onsite storage and transferring and shipping the fuel (and/or the baskets) to a federally operated remote handling facility (RHF). Numerous options or at-reactor and away-from-reactor handling were investigated. Materials handling flowsheets were developed along with conceptual designs for the equipment and tools required to handle and open the MSBs. The handling options were evaluated and compared to a reference case, fuel handling sequence (i.e., fuel assemblies are taken from the fuel pool, shipped to a receiving and handling facility and placed into interim storage). The main parameters analyzed are throughout, radiation dose burden and cost. In addition to evaluating the handling of MSBs, this work also evaluated handling consolidated fuel canisters (CFCs). In summary, the handling of MSBs and CFCs in the store, ship and bury fuel cycle was found to be feasible and, under some conditions, to offer significant benefits in terms of throughput, cost and safety. 14 refs., 20 figs., 24 tabs.

38106 (EUR–11866) **Long-term storage of spent fuel from light-water reactors.** Fettel, W.; Kaspar, G.; Guenther, H. Commission of the European Communities, Luxembourg (Luxembourg). 1988. 140p. Available from NTIS (US Sales Only), PC A07/MF A01.

Very long-term interim storage of spent light-water-reactor fuel is an important part of the back-end of the nuclear fuel cycle, particularly in countries where disposal facilities will be available only in the distant future. Therefore, different storage concepts have been investigated as regards costs, behaviour of spent fuel assemblies and activity release. The storage concepts are interim storage of spent fuel assemblies in cask storage facilities, independent modular wet storage facilities and independent modular dry vault storage facilities. Costs for a number of waste management options have been calculated for two selected nuclear power programmes and three different storage concepts, considering various general price increases and interest rates. Risks to the integrity of stored fuel assemblies have been investigated and, in particular, processes endangering the tightness of the fuel rod: external and internal oxidation, hydrogen absorption and diffusion, crack propagation and creep deformation. The investigations of these mechanisms have shown that wet storage of spent fuel is safe and feasible at least for a hundred years. The analysis of dry storage behaviour indicates a limit to the dry storage temperature only, but no restriction as

regards the length of the storage period has been detected. The activity release behaviour of fuel assemblies stored under water was derived from in-service measurements at nuclear power plants, irradiation of samples, leach-tests and measurements of radionuclides in the air above storage ponds. The analysis shows that, even when a large number of detective fuel rods are present in the storage facility, the limit values for radiation exposure are not exceeded. These limits may be reached only in hypothetical incidents supposing complete failure of container integrity, when a sufficient number of defective rods is present.

38107 (GAO/RCED–87-92) **Nuclear waste.** General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. 1988. 70p. Available from General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Department of Energy is proposing the construction of a monitored retrievable storage facility primarily for waste preparation and packaging rather than for long-term storage as envisioned by the Nuclear Waste Policy Act. While the MRS would be capable of storing spent fuel for long periods, most of the storage that would take place at the facility would be temporary until the spent fuel could be shipped to the repository. GAO does not believe that DOE's proposal is sufficiently comprehensive for the Congress to make an informed decision on the cost of, need for, or consequences of integrating an MRS into the waste management system, or whether the benefits attributed to the MRS can be better achieved by other means. The Congress needs to be aware of the consequences of not approving an MRS as well as the implications of authorizing it. DOE's proposal does not identify the most effective configuration of the authorized waste management system for the Congress to use as a basis for comparison in deciding if the benefits of the proposed MRS facility are worth its added cost to the waste program.

38108 New developments in dry spent fuel storage licensing. Roberts, J.P. (U.S. Nuclear Regulatory Commission (US)). v.v of Proceedings of the Institute of Nuclear Materials Management spent fuel management seminar V. C.E. Pietri, Northbrook, IL (1988). (CONF-880125–: Institute of Nuclear Materials Management: spent fuel management seminar, Washington, DC, USA, 20-22 Jan 1988).

Dry spent fuel storage is an option available to utilities. Developments, both technical and regulatory, continue to extend the scope of this option. For utilities the growing availability of diverse dry storage technologies and the possibility of increasing modular storage capacity provide additional alternatives for meeting added spent fuel storage capacity requirements in the coming decade. Two rulemaking actions have been taken to amend 10 CFR Part 72 in accordance with the instructions of Congress in the NWPA. These regulatory developments are expected, on one hand, to provide for more efficient at-reactor-site dry storage licensing through storage cask certification and general license provisions for utilities and, on the other hand, to allow for offsite long-term storage of spent fuel and high level waste in a MRS by DOE, should Congres authorize that activity.

38109 Inspection/measurement requirements for spent fuel assemblies and canned spent fuel. McBride, J.A. (E.R. Johnson Associates, Inc., Oakton, VA (US)). v.v of Proceedings of the Institute of Nuclear Materials Management spent fuel management seminar V. C.E. Pietri, Northbrook, IL (1988). (CONF-880125–: Institute of Nuclear Materials Management: spent fuel management seminar, Washington, DC, USA, 20-22 Jan 1988).

The matter of the inspections and/or measurements that may be required to be performed on spent nuclear fuel as a condition of acceptance of the fuel for disposal by the Department of Energy has been the subject of considerable discussion by individuals with responsibility for spent fuel management. This paper discusses questions related to the purposes of such inspections or tests, where they might be carried out, and most particularly the nature of the real or perceived need for the results of the inspections/measurements and the justification for performing them. Four categories of spent fuel and spent fuel-derived materials are considered: spent fuel assemblies, canistered spent fuel assemblies, consolidated rods, and non-fuel-bearing materials, including spent fuel assembly structural items and possibly other radioactive core components.

38110 Dry rod consolidation advancements in the OCRWM programs. Fisher, M.W. (U.S. Dept. of Energy, Idaho Operations Office (US)). v.v of Proceedings of the Institute of Nuclear Materials Management spent fuel management seminar V. C.E. Pietri, Northbrook, IL (1988). (CONF-880125–: Institute of Nuclear Materials Management: spent fuel management seminar, Washington, DC, USA, 20-22 Jan 1988).

As part of the Office of Civilian Radioactive Waste Management (OCRWM) initiatives, the Idaho Operations Office is conducting research and development activities on dry rod consolidation technologies. There are two programs at Idaho sponsored by OCRWM that are studying dry rod consolidation. The first program that has been conducted is the Dry Rod Consolidation Technology (DRCT) Project. Using equipment designed by EG and G, Idaho, 48 Westinghouse 15x15 fuel assemblies were consolidated during the summer of 1987. This was the first successful horizontal dry consolidation effort in the United States. The second program, the Prototypical Rod Consolidation Demonstration Program (PCDP), involves the development of prototypical dry rod consolidation equipment that is able to consolidate the majority of the spent fuels in the United States.

38111 Issues concerning standard contract spent fuel acceptance criteria. McLeod, N.B. (E.R. Johnson Associates, Inc., Oakton, VA (US)). v.v of Proceedings of the Institute of Nuclear Materials Management spent fuel management seminar V. C.E. Pietri, Northbrook, IL (1988). (CONF-880125–: Institute of Nuclear Materials Management: spent fuel management seminar, Washington, DC, USA, 20-22 Jan 1988).

The purpose of this paper is to summarize the waste acceptance criteria issues that have arisen since the Standard Contact was promulgated. The technical nature of these issues and the general viewpoints of the utilities and DOE are summarized. Two issues - the standard canister and the oldest-first delivery requirement are identified as priority issues.

38112 Characterization of activated metals in spent fuel hardware. Luksic, A.T. (Pacific Northwest Lab. (US)). v.v of Proceedings of the Institute of Nuclear Materials Management spent fuel management seminar V. C.E. Pietri, Northbrook, IL (1988). (CONF-880125–: Institute of Nuclear Materials Management: spent fuel management seminar, Washington, DC, USA, 20-22 Jan 1988).

Pacific Northwest Laboratory (PNL), for the U.S. Department of Energy, has been investigating the components that make up the structural portion of spent fuel assemblies. This investigation has been ongoing for the past few years and has included identifying the materials used, the quantities involved, and options for their disposal. The subject of this paper is to describe work that is currently being done at PNL to measure radionuclide activities in these activated metals.

38113 Preliminary definition of the DOE/OCRWM transportation operating system. Rawl, R.R. (Chemical Technology Div., Oak Ridge National Lab., Oak Ridge, TN (US)); Kline, S.C. v.v of Proceedings of the Institute of Nuclear Materials Management spent fuel management seminar V. C.E. Pietri, Northbrook, IL (1988). (CONF-880125–: Institute of Nuclear Materials Management: spent fuel management seminar, Washington, DC, USA, 20-22 Jan 1988).

This paper is based on the report and presents a summary of the preliminary definition of transportation operations activities for the cask shipment cycle, commencing with the dispatch of an empty cask, to loading and unloading of cask contents, and preparation of the empty cask for redispatch. It first presents a high-level description of the transportation cycle and then further describes each of the major activities in greater detail. For simplicity of presentation, the highway node of transport is most often used to describe activities. Major activities and functions of the system are organized into a first cut of how they could be allocated to specific facilities. The reader should keep in mind that the assignment of functions and the aggregation of these into specific facilities are tasks which have yet to be performed. This paper simply presents a first look at possible groupings of the functions on a facility basis.

38114 Summary of international activities in spent fuel storage. Shelor, D.E. (U.S. Dept. of Energy (US)); Whittington, W. v.v of Proceedings of the Institute of Nuclear Materials Management spent

fuel management seminar V. C.E. Pietri, Northbrook, IL (1988). (CONF-880125–: Institute of Nuclear Materials Management: spent fuel management seminar, Washington, DC, USA, 20-22 Jan 1988).

In 1986, nuclear power electrical generating systems in operation worldwide numbered 397 with a combined net capacity of 273 Gigawatts electric (GWe). This net production resulted in approximately 39 thousand metric tonnes of Initial Heavy Metal being discharged as spent fuel from these systems. The storage requirements for spent fuel discharged differ in each nation and are dependent on national strategies for fuel cycle management. The design of spent fuel storage facilities is a function of the type of nuclear electrical generating system adopted, and, therefore, the spent fuel characteristics. This paper summarizes the current international status of spent-fuel storage strategies.

38115 **A preliminary assessment of system cost impacts of using transportable storage casks and other shippable metal casks in the utility/DOE spent fuel management system.** Johnson, E.R. (E.R. Johnson Associates, Inc., Oakton, VA (US)). v.v of Proceedings of the Institute of Nuclear Materials Management spent fuel management seminar V. C.E. Pietri, Northbrook, IL (1988). (CONF-880125–: Institute of Nuclear Materials Management: spent fuel management seminar, Washington, DC, USA, 20-22 Jan 1988).

In view of the foregoing, a study was conducted by E.R. Johnson Associates, Inc. and H and R Technical Associates, Inc. to determine the prospective viability of the use of TSCs and shippable SOCs in the combined utility/DOE system. This study considered costs, ALARA considerations and the logistics of the use and delivery of casks to the DOE system by utilities. It was intended that this study would result in a technical and cost resource base that could be used for evaluating various strategies and scenarios for deploying TSCs or SOCs in the combined utility/DOE spent fuel management system with respect to the prospective economic advantage that could be realized.

0510 Marketing, Economics, and By-products

Refer also to citation(s) 38115, 38160

38116 (DOE/EIA–0368) **An assessment of the EUREKA uranium mining and milling model.** Thomas, C.R.; Marable, J.H.; deSaussure, G.; Stewart, L. USDOE Energy Information Administration, Washington, DC (USA). Office of Statistical Standards; Oak Ridge National Lab., TN (USA). Sep 1982. 253p. Sponsored by DOE Management & Administration. DOE Contract AC05-84OR21400. Order Number DE89014992/JAW. Available from NTIS, PC A12/MF A01 - GPO - OSTI; GPO Dep.

At the request of the Office of Energy Information Validation (OEIV), an eight-month assessment of the EUREKA model was undertaken by the Model Evaluation Team (MET) of the Oak Ridge National Laboratory (ORNL). This report presents the results of that assessment. The assessment of EUREKA includes the following tasks: a brief description of the EUREKA code and identification of users; an assessment of the adequacy of the EUREKA documentation relative to guidelines for documentation issued by the office of Analysis oversight and Access (OAOA); a review of MET's actual operating experience; an assessment of the economic structure of the EUREKA model; a verification that the code runs as intended; a sensitivity analysis of market price to all key input parameters in the code; and a survey of the users' experience with forecasts made using the EUREKA code. 25 refs.

0520 Waste Management

Refer also to citation(s) 38110, 38211, 38212, 38213, 38215, 38216, 38217, 38218, 38219, 38220, 38221, 38222, 38223, 38224, 38252, 38778, 38810, 38842, 39765

38117 (AECL–6186(rev.4)) **Radioactive waste management in Canada. AECL publications and other literature 1983-1985.** Hawley, N.J. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. Sep 1986. 54p. Order Number DE89631587/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

This bibliography is an up-date to AECL-6186(Rev 3), 1952-1982, 'Radioactive Waste Management in Canada AECL Publications and Other Literature' compiled by Dianne Wallace. Canadian publications from outside contractors concerning the Canadian Nuclear Fuel Waste Management Program are included in addition to Atomic Energy of Canada Limited reports and papers. 252 refs.

38118 (BMU–1988-194) **Derivation of activity limits for low-level radioactive waste.** Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten. Mueller, M.K.; Kucheida, D.; Regauer, F.; Wirth, E. Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene. 1988. 124p. (In German). Contract BMU St.Sch. 00988. Available from GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.).

Precondition for a conventional disposal of low-level radioactive waste together with domestic refuse is that the radiation load for the population and every single person (inhalation, soil radiation, seepage water, erosion) is so low that it need not be taken into consideration for radiation protection measures. The IAEA suggests an individual dose limit value of 1 mrem=10 μSv per year (de minimis concept). This dose limit value was accepted for the calculation of the activity limit values. The possible exposure patherays in domestic refuse disposal were analysed and suitable exposure models were developed. With the help of these models, the concentrations of activity in contaminated waste was calculated for 81 radionuclides; the concentrations of activity showed that the individual dosis was 10 μSv/a. The thus calculated activity limit values are compared to the 10^{-4}-fold of the exemption limits of the Radiation Protection Ordinance section 4 subsection 2e; these exemption limits can serve under certain conditions as limit values for a disposal of low-level radioactive wastes not requiring approval. The basis for the calculation is the conservative estimation that a total volume of 5000 m^3 dumpable low-level radioactive waste with a specific density of 0.5 t/m^3 occur per year. (orig./HP).

38119 (CEA-TR–2444) **Volatility of ^{137}Cs and ^{90}Sr from high-level waste glass.** Nakamura, H.; Kikkawa, S.; Sato, M.; Kamizono, H.; Senoo, M.; Tashiro, S. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Jun 1988. 30p. (In French). Order Number DE89791919/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Volatility of ^{137}Cs and ^{90}Sr from simulated high-level waste glass was examined in a closed system. The sample containing ^{137}Cs or ^{90}Sr was placed in a double-crucible, heated at a given temperature for 3 days and cooled to room temperature. Then the activity of ^{137}Cs or ^{90}Sr of the crucible was measured. Volatility of ^{137}Cs at 800^{0}C was measured to be about 2 x 10^{-2} g/cm^2.day. The amount of the leakage of ^{137}Cs from the inner crucible to the outer crucible was very small. Volatility of ^{137}Cs at 400^{0}C was about 1.6 x 10^{-6} g/cm^2.day, which was almost the same as that of ^{90}Sr at 400^{0}C. This may indicate that fine particles adhering to the surface of the sample are the main cause of air contamination when the temperature is less than 400^{0}C. Part of the ^{137}Cs that was deposited on the surface of the outer crucible (stainless steel) dissolved in water at room temperature, which means that ^{137}Cs deposited on a stainless steel surface may be easily removed by a decontamination process.

38120 **Role of uncertainty in the basalt waste isolation project.** Knepp, A.J. (Department of Energy, Richland, WA (USA)); Dahlem, D.H. pp. 658 of Geostatistical, sensitivity, and uncertainty methods for ground-water flow and radionuclide transport modeling. Proceedings. Buxton, B.E. (ed.) Battelle Memorial Institute, Columbus, OH (1989). From Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference; San Francisco, CA, USA; 15-17 Sep 1987.

The current national Civilian Radioactive Waste Management (CRWM) Program to select a mined geologic repository will likely require the extensive use of probabilistic techniques to quantify uncertainty in predictions of repository isolation performance. Performance of nonhomogeneous, geologic hydrologic, and chemical systems must be predicted over time frames of thousands of years and therefore will likely contain significant uncertainty. A qualitative assessment of our limited ability to interrogate the site in a nondestructive manner coupled with the early stage of development in the

pertinent geosciences support this statement. The success of the approach to incorporate what currently appears to be an appreciable element of uncertainty into the predictions of repository performance will play an important role in acquiring a license to operate and in establishing the level of safety associated with the concept of long-term geologic storage of nuclear waste. This paper presents a brief background on the Hanford Site and the repository program, references the sources that establish the legislative requirement to quantify uncertainties in performance predictions, and summarized the present and future program at the Hanford Site in this area. The decision to quantify significant sources of uncertainties has had a major impact on the direction of the site characterization program here at Hanford. The paper concludes with a number of observations on the impacts of this decision.

38121 Improving the efficiency of Monte Carlo simulation for groundwater transport models. Veneziano, D. (Massachusetts Institute of Technology, Cambridge (USA)); Kulkarni, R.; Luster, G.; Rao, G.; Salhotra, A. pp. 658 of Geostatistical, sensitivity, and uncertainty methods for ground-water flow and radionuclide transport modeling. Proceedings. Buxton, B.E. (ed.) Battelle Memorial Institute, Columbus, OH (1989). From Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference; San Francisco, CA, USA; 15-17 Sep 1987.

When applied to complicated groundwater models or when used to estimate the probability of exceeding high pollutant concentrations, the Monte Carlo method becomes either imprecise or expensive. Two methods are proposed here that substantially reduce the computational requirements in comparison to Monte Carlo (MC) simulation when the objective is to estimate a given fractile of the output concentration. The methods are general with respect to the probability distribution of the uncertain source and model parameters and with respect to the algorithm that estimates the desired concentration, given such parameters. One of the methods uses a combination of several uncertainty-propagation techniques; the other is an adaptation of the Rackwitz-Riessler algorithm of system reliability analysis. Both methods employ recursive linearization of the mass transport model. The methods have been implemented in a FORTRAN computer code and used to evaluate the 0.9 fractile of downgradient concentration using a semianalytical three-dimensional mass transport model. Results are typically close to direct MC estimates, and the CPU time is about two orders of magnitude less than that required by the MC method. This is an important feature of the proposed methods, especially for the evaluation of exposure through complicated numerical algorithms.

38122 Sensitivity of Whiteshell Geosphere modeling results to dimensionality (2-D/3-D) of the computer simulations employed. Reid, J.A.K. (Atomic Energy of Canada Limited, Pinawa, Manitoba); Chan, T. pp. 658 of Geostatistical, sensitivity, and uncertainty methods for ground-water flow and radionuclide transport modeling. Proceedings. Buxton, B.E. (ed.) Battelle Memorial Institute, Columbus, OH (1989). From Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference; San Francisco, CA, USA; 15-17 Sep 1987.

The Whiteshell Geosphere Conceptual Model has been assembles as a basis for two- and three-dimensional simulations to predict water flows from a hypothetical nuclear waste vault. The conceptual model is consistent with surface and subsurface geological, geophysical, and hydrogeological data from the granite batholith and surrounding country rock that comprise the Whiteshell Research Area (WRA) in southeastern Manitoba, Canada. The MOTIF finite-element code has been applied to simulate the coupled processes of groundwater flow and heat transport. Convective transport of inert contaminants from a hypothetical nuclear fuel waste vault, through the geosphere, to the biosphere was simulated using a particle-tracking technique. Hydraulic properties of the elements of the intersection of a major fracture zone with the hypothetical vault were changed to represent the effect of grouting. Results in the form of heads, water velocities, and particle tracks from two- and three-dimensional finite element simulations are compared. Some three-dimensional (3-D) velocity patterns and fracture-grouting effects cannot be represented in two-dimensional (2-D) models.

38123 Development of a methodology of geochemical sensitivity analysis for performance assessment. Siegel, M.D. (Sandia National Laboratories, Albuquerque, NM (USA)); Leckie, J.O.; Phillips, S.L.; Kelly, W.R. pp. 658 of Geostatistical, sensitivity, and uncertainty methods for ground-water flow and radionuclide transport modeling. Proceedings. Buxton, B.E. (ed.) Battelle Memorial Institute, Columbus, OH (1989). DOE Contract AC04-76DP00789. From Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference; San Francisco, CA, USA; 15-17 Sep 1987.

The objective of this geochemical sensitivity analysis is to formulate criteria for valid simplification of radionuclide transport models used in performance assessment. In the past, limitations in available models, data, and computer codes have necessitated the use of simplified representations of radionuclide chemistry and water/rock interactions in analyses of high-level waste (HLW) repositories. The validity of these simplifying approximations is a crucial element in the design of performance assessment methods and must be assessed relative to the appropriate performance measure and ranges of physicochemical parameter values. In this paper, we illustrate the complementary roles played by (1) simple transport models designed to bound the radionuclide discharge over wide ranges of physicochemical conditions, (2) detailed geochemical models that provide a structured method to obtain reliable information about solute/rock/water interactions, and (3) sensitivity and uncertainty analysis techniques used to assess the significance of errors in both data and models.

38124 Representative elements: a step to large-scale fracture system simulation. Clemo, T.M. (Idaho National Engineering Lab., Idaho Falls (USA)). pp. 658 of Geostatistical, sensitivity, and uncertainty methods for ground-water flow and radionuclide transport modeling. Proceedings. Buxton, B.E. (ed.) Battelle Memorial Institute, Columbus, OH (1989). DOE Contract AC07-76ID01570. From Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference; San Francisco, CA, USA; 15-17 Sep 1987.

Large-scale simulation of flow and transport in fractured media requires the development of a technique to represent the effect of a large number of fractures. Representative elements are used as a tool to model a subset of a fracture system as a single distributed entity. Representative elements are part of a modeling concept called dual permeability. Dual permeability modeling combines discrete fracture simulation of the most important fractures with the distributed modeling of the less important fractures of a fracture system. This study investigates the use of stochastic analysis to determine properties of representative elements. Given an assumption of fully developed laminar flow, the net fracture conductivities and hence flow velocities can be determined from descriptive statistics of fracture spacing, orientation, aperture, and extent. The distribution of physical characteristics about their mean leads to a distribution of the associated conductivities. The variance of hydraulic conductivity induces dispersion into the transport process. Simple fracture systems are treated to demonstrate the usefulness of stochastic analysis. Explicit equations for conductivity of an element are developed and the dispersion characteristics are shown. Explicit formulation of the hydraulic conductivity and transport dispersion reveals the dependence of these important characteristics on the parameters used to describe the fracture system. Understanding these dependencies will help to focus efforts to identify the characteristics of fracture systems. Simulations of stochastically generated fracture sets do not provide this explicit functional dependence on the fracture system parameters.

38125 Uncertainty in forecasting breakthrough of fluid transported through fractures. Horne, R.N. (Stanford Univ., CA (USA)). pp. 658 of Geostatistical, sensitivity, and uncertainty methods for ground-water flow and radionuclide transport modeling. Proceedings. Buxton, B.E. (ed.) Battelle Memorial Institute, Columbus, OH (1989). From Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference; San Francisco, CA, USA; 15-17 Sep 1987.

Tracer experiments in geothermal reservoirs emphasize the very great variability in rates of fluid movement through fractured rocks. This variability extends from the 10-meter to the kilometer-length scale. Thus tracer returns have been observed at some locations within hours at distances of up to 1 kilometer from the injection

point, while other much nearer locations in the same formation do not observe the tracer until much later. In addition, transport rates have sometimes been extremely fast (up to 100 m/hr) even over such distances. This paper discusses the conclusions reached after compiling the results of a large number of tracer tests in several different fractured reservoirs. It is evident in some cases that large-scale geological features, such as faults, are responsible for the variations in tracer return time. In other cases, there is no clear physical description that explains the differences. These results suggest that there will be no a priori way of forecasting transport rates in fractured systems without performing a tracer test.

38126 Validation of stochastic flow and transport models for unsaturated soils: field study and preliminary results. Nicholson, T.J. (Nuclear Regulatory Commission, Washington, DC (USA)); Gee, G.W.; Jacobson, E.A.; Wierenga, P.J.; Polmann, D.J.; McLaughlin, D.B.; Gelhar, L.W. pp. 658 of Geostatistical, sensitivity, and uncertainty methods for ground-water flow and radionuclide transport modeling. Proceedings. Buxton, B.E. (ed.) Battelle Memorial Institute, Columbus, OH (1989). From Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference; San Francisco, CA, USA; 15-17 Sep 1987.

The US Nuclear Regulatory Commission (NRC) is funding a field study to collect a data base specially designed to validate a stochastic unsaturated flow and transport theory. The stochastic approach is an efficient methodology for characterizing and assessing spatial variability of the hydraulic properties of soils in the unsaturated zone. At the New Mexico State University (NMSU) field experimental station, an observational trench 4.8 m x 26.5 m and 6 m deep has been excavated. Instrumentation located at various points from the trench face monitored the advancing wetting front and coincident tracers resulting from constant rate infiltration from an irrigation drip system adjacent to the trench. The measured hydraulic properties were analyzed, and directional semivariograms were developed to investigate the statistical characteristics of the hydraulic conductivity data set. The results indicated that the principal direction of anisotropy corresponds to the horizontal and vertical directions of flow. Measured soil moisture contents and tensions due to the advancing wetting showed qualitative agreement between the stochastic simulations and the observed field data, particularly for the horizontal tension distributions. Full validation has yet to be achieved. Further field experiments are being designed and will be conducted to examine transient flow and transport conditions.

38127 Parameter sensitivity and importance for radionuclide transport in double-porosity systems. Tomasko, D. (Sandia National Lab., Albuquerque, NM (USA)); Reeves, M.; Kelley, V.A.; Pickens, J.F. pp. 658 of Geostatistical, sensitivity, and uncertainty methods for ground-water flow and radionuclide transport modeling. Proceedings. Buxton, B.E. (ed.) Battelle Memorial Institute, Columbus, OH (1989). DOE Contract AC04-76DP00789. From Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference; San Francisco, CA, USA; 15-17 Sep 1987.

A type-curve methodology using four dimensionless parameters is developed for modeling radionuclide transport through a fractured, double-porosity system. A dimensionless velocity and a dimensionless dispersion coefficient are used to characterize transport through the fractures, while a dimensionless solute storage enhancement coefficient and a dimensionless time constant for matrix diffusion are used to characterize the coupling of the matrix to the fractures. Using the dimensionless parameters, parameter-variation curves are developed to exhibit the general response of a performance measure, nuclide travel time, with respect to the entire range of parameter variability. Parameter sensitivities are then calculated as the normalized derivatives of the parameter-variation curves for the dimensionless set of base-case values. The parameter sensitivities are then recast to find the response of the performance measure in terms of a natural set of dimensional parameters that characterize the double-porosity transport model. As a final step, importance coefficients are defined to ascertain the relative ranking of the natural set of base-case parameters. The method is demonstrated by presenting the results obtained by modeling the transport of an infinitely long-lived radionuclide through the Culebra Dolomite Member of the Rustler Formation, the most transmissive zone located above the Waste Isolation Pilot Plant in southeastern New Mexico.

38128 Sensitivity index as a screening tool in the analysis of ground-water contaminant transport. Fjeld, R.A. (Clemson Univ., SC (USA)); Sill, B.L.; Looney, B.B. pp. 658 of Geostatistical, sensitivity, and uncertainty methods for ground-water flow and radionuclide transport modeling. Proceedings. Buxton, B.E. (ed.) Battelle Memorial Institute, Columbus, OH (1989). From Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference; San Francisco, CA, USA; 15-17 Sep 1987.

A method is presented that incorporates features of Tomovic's sensitivity index to facilitate the time-dependent sensitivity analysis of ground-water contaminant transport in a radioactive risk assessment application. The basic approach involves specification of nominal, minimum, and maximum values of the transport parameters, calculation of contaminant concentrations corresponding to the parameter values, and, finally, calculation of the sensitivity index as a function of time. A key aspect of the method is definition of an appropriate sensitivity index. In the application presented here, an index is defined that emphasizes deviations from nominal concentrations that are significant relative to the maximum nominal concentration and, at the leading edge of the contaminant breakthrough curve, deemphasizes the uncertainties, which are large on a relative basis but small on an absolute basis. The methods is illustrated using a simple one-dimensional ground-water advection-dispersion model and is applied to a radioactive waste disposal site. An uncertainty analysis of the same site is performed by Monte Carlo simulation for comparison.

38129 Effect of variable fracture permeability/matrix permeability ratios on three-dimensional fractured rock hydraulic conductivity. Rasmussen, T.C. (Univ. of Arizona, Tucson (USA)); Yeh, T.C.J.; Evans, D.D. pp. 658 of Geostatistical, sensitivity, and uncertainty methods for ground-water flow and radionuclide transport modeling. Proceedings. Buxton, B.E. (ed.) Battelle Memorial Institute, Columbus, OH (1989). From Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference; San Francisco, CA, USA; 15-17 Sep 1987.

A sensitivity analysis is implemented using the boundary integral method to determine the relative contribution to total liquid flow through a rock block both by flow through the rock matrix and by flow through discrete fractures embedded within the rock matrix. Total liquid flow through a rock block with embedded fractures of arbitrary density, orientation, permeability, shape, and areal extent is simulated by discretizing the fracture-matrix boundary and the exterior surface of the rock sample using boundary elements. Steady liquid flow through fractures is computed by creating nodes along the outer rim of each fracture and then routing between nodes within the fracture plane using a two-dimensional boundary integral formulation. Flow between fractures is calculated by assigning boundary nodes along fracture intersections. Liquid flow through the rock matrix is calculated by employing a three-dimensional boundary integral formulation for nodes on fracture boundaries and on the exterior surfaces of the rock block. All nodes within the network are linked using the three-dimensional boundary integral formulation. Constant matrix permeability, k_m, and fracture permeability, k_f, within individual fractures are assumed. This assumption provides the ability to account for steady liquid flow through fractures and the rock matrix when complex, random shapes of matrix blocks between fractures are present.

38130 Three-dimensional geometric modeling of a fracture network. Chiles, J.P. (Bureau de Recherches Geologiques èt Minieres, Orleans (France)). pp. 658 of Geostatistical, sensitivity, and uncertainty methods for ground-water flow and radionuclide transport modeling. Proceedings. Buxton, B.E. (ed.) Battelle Memorial Institute, Columbus, OH (1989). From Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference; San Francisco, CA, USA; 15-17 Sep 1987.

Fluid-flow studies of fractured rocks require a three-dimensional modeling of the fracture network. Because the complexity of reality does not allow a complete description of the actual network, it is

therefore necessary to use Monte-Carlo models. Various basic models can be used depending on the situation: random infinite fractures (planes), random finite fractures (polygons or discs), and locally self-similar fractal networks. Other models of easy simulation can be derived by mixing, clustering, and regionalizing the parameters. These models are reviewed. Emphasis is placed on the determination of the parameters by means of morphological, statistical, geostatistical, and fractal tools that can be used with one-dimensional data (boreholes) or two-dimensional data (outcrops and drift walls). The last section explains how to condition a three-dimensional simulation on the data.

38131 Some recent observations of channeling in fractured rocks - its potential impact on radionuclide migration. Neretnieks, I. (Royal Institute of Technology, Stockholm (Sweden)); Abelin, H.; Birgersson, L. pp. 658 of Geostatistical, sensitivity, and uncertainty methods for ground-water flow and radionuclide transport modeling. Proceedings. Buxton, B.E. (ed.) Battelle Memorial Institute, Columbus, OH (1989). From Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference; San Francisco, CA, USA; 15-17 Sep 1987.

During the last few years several observations in the field have been made to indicate that water flow is very unevenly distributed in fractured crystalline rocks. In a field experiment in the Stripa international research project it was noted that in several individual fractures that were studied in some detail, most of the naturally flowing water emerged in a few spots. Observations over more than 5 km in two long tunnels, the Bolmen and Kymmen tunnels, show that the water emerges in distinct spots. In the site of the Repository for Reactor Waste, Slutfoutforvar for Reaktoravfall (SFR), that was recently excavated, a detailed mapping of all wet spots shows that there is on the average about one wet spot every 85 m^2. These and similar observations have led us to investigate the potential impact of pure channel flow on radionuclide transport and retardation. A simple model was made based on the assumption that the channels are independent over a certain distance. The transport properties in such a bundle of channels have been shown to be different in some important respects from the properties of a highly fractured medium. Model calculations show that the few fast channels with little sorption area may carry sorbing radionuclides at a rate that may not let the nuclides decay as well as if the rock were more, and more evenly, fractured.

38132 Transport of dissolved substances in fissured granite. Liedtke, L. (Federal Institute for Geosciences and Natural Resources, Hannover (Germany, F.R.)); Pahl, A. pp. 658 of Geostatistical, sensitivity, and uncertainty methods for ground-water flow and radionuclide transport modeling. Proceedings. Buxton, B.E. (ed.) Battelle Memorial Institute, Columbus, OH (1989). From Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference; San Francisco, CA, USA; 15-17 Sep 1987.

Several research projects have been under way in the Grimsel rock laboratory (Switzerland) since 1983. In the Fracture System Flow Test project, the development of methods and equipment for studying flow rate in fissured rock is being continued. Ten cored boreholes up to 135 m long were drilled for this purpose. The configuration of these holes, serving as injection boreholes and observation holes in specific rock sections, was designed according to the geological structures in the rock around the tunnels of the rock laboratory. Since 1986, tracers have been added to the injected water so that detailed measurements on injected water volumes, pressure heads, and flow rates could be made. Nonlinear flow rates are used for calculating the size of the fissures, the storage capacity, and the permeability tensor under non-steady-state conditions. The calculations were done with a finite-element program. With this program fissures can be modeled using tubular, discoid, or any other spatial element. Variation of the individual parameters provides an indication of the quality of the in situ experiments and the numerical models. The methods and results of the experiments will be described.

38133 Stochastic parameter estimation for nuclear repository site characterization at Hanford, Washington. Djerrari, A.M. (EWA, Inc., Minneapolis, MN (USA)); Nguyen, V.V. pp. 658 of Geostatistical, sensitivity, and uncertainty methods for ground-water flow and radionuclide transport modeling. Proceedings. Buxton, B.E. (ed.) Battelle Memorial Institute, Columbus, OH (1989). From Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference; San Francisco, CA, USA; 15-17 Sep 1987.

Pre-waste emplacement groundwater travel-times are being used by the US Department of Energy as one measure for ultimately selecting a suitable site for a high-level nuclear waste repository. To compute groundwater travel times, the groundwater flow pattern in the vicinity of the proposed repository location must be delineated and pertinent hydrologic parameters must be identified from the baseline data. In this paper, transmissivity and hydraulic head fields are estimated using a geostatistical solution to the inverse problem. An application to the Hanford Site is presented. The sensitivity of the estimated hydrologic fields to the number of available data points is analyzed through simulations. The predicted fields can be significantly different from one another depending on the number of data points used in the identification of the hydraulic head and transmissivity field geostatistical parameters.

38134 Imaging of spatial uncertainty: a non-gaussian approach. Journel, A.G. (Stanford Univ., CA (USA)). pp. 658 of Geostatistical, sensitivity, and uncertainty methods for ground-water flow and radionuclide transport modeling. Proceedings. Buxton, B.E. (ed.) Battelle Memorial Institute, Columbus, OH (1989). From Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference; San Francisco, CA, USA; 15-17 Sep 1987.

Gaussian-related models for stochastic simulation of spatial uncertainty do not offer the flexibility to reproduce patterns of spatial connectivity specific to extreme values (e.g., fractures). The nonparametric indicator approach allows reproduction of several spatial connectivity functions, and the indicator data coding allows conditioning by both hard and soft data. The resulting alternative, equiprobable images of the spatial distribution of the attribute considered present low entropy features that may be critical to repository characterization. The paper is methodological in nature.

38135 Alternative approach to uncertainty in risk analysis and an exactly soluble model for a nuclear waste repository. Corbett, J.O. (Berkeley Nuclear Laboratories, Gloucestershire (England)); Hodgkinson, D.P.; Robinson, P.C. pp. 658 of Geostatistical, sensitivity, and uncertainty methods for ground-water flow and radionuclide transport modeling. Proceedings. Buxton, B.E. (ed.) Battelle Memorial Institute, Columbus, OH (1989). From Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference; San Francisco, CA, USA; 15-17 Sep 1987.

Probabilistic risk analysis needs careful interpretation if the spread of predicted consequences is dominated by uncertainty due to lack of data. This paper treats the situation where the risk appears to be dominated by the possibility of a number of uncertain quantities all lying in a narrowly defined region that gives rise to high consequences. The problem is demonstrated with a simple model of radionuclide dispersal from an underground repository. It is shown that the convergence of Monte Carlo calculations may be very erratic, and the results may strongly reflect any arbitrariness in assigning the original probability distributions. An iterative approach is suggested, in which a standard optimization program is used to locate and measure the high consequence peaks. The aim is to ensure that the final analysis correctly represents expert judgment in relation to the high consequence regions.

38136 Probability encoding: quantifying judgmental uncertainty over hydrologic parameters for basalt. Merkhofer, M.W. (Applied Decision Analysis, Inc., Menlo Park, CA (USA)); Runchal, A.K. pp. 658 of Geostatistical, sensitivity, and uncertainty methods for ground-water flow and radionuclide transport modeling. Proceedings. Buxton, B.E. (ed.) Battelle Memorial Institute, Columbus, OH (1989). From Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference; San Francisco, CA, USA; 15-17 Sep 1987.

Judgmental probabilities (together with Bayesian analysis) provide a means for overcoming the lack-of-data problems associated with classical methods for uncertainty analysis. Judgmental probabilities

may be obtained through a formal process called probability encoding. This paper described probability encoding methodology and presents an application that quantified expert uncertainty regarding key hydrologic parameters at the potential repository site at Hanford, Washington. The SRI probability encoding process was applied to quantify expert uncertainty regarding (1) the effective porosity of the Cohassett basalt flow top and flow interior and (2) the ratio of vertical to horizontal conductivity (anisotropy ratio) of the Cohassett basalt flow interior. Each variable was assessed on two scales, a megascale (100 to 1,000 meters) and a macroscale (1 to 10 meters). Background material, which included measured site-specific, test-based values of the pertinent parameters, was prepared and distributed to participants prior to the probability encoding sessions.

38137 (CONF-890631–59) **Transportation operations functions of the federal waste management system.** Shappert, L.B.; Klimas, M.J. Oak Ridge National Lab., TN (USA). 1989. 9p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC05-84OR21400. From International symposium on packaging and transporting of radioactive materials; Washington, DC, USA; 11-16 Jun 1989. Order Number DE89015041/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper documents the functions that are necessary to operate the OCRWM transportation system. OCRWM's mission is to accept and transport spent fuel and high-level waste from waste generators to FWMS facilities. The emphasis is on transportation operations and assumes that all necessary facilities are in place and equipment designs and specifications are available to permit the system to operate properly. The information reported in this paper was developed for TOPO and is compatible with the draft revision of the Waste Management System Requirements and Description (SRD). 5 refs.

38138 (CONF-890867–1) **Geochemical controls on groundwater chemistry in shales.** Von Damm, K.L. Oak Ridge National Lab., TN (USA). 1989. 5p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC05-84OR21400. From 6. international symposium on water-rock interaction; Malvern (UK); 3-9 Aug 1989. Order Number DE89011237/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The chemistry of groundwaters is one of the most important parameters in determining the mobility of species within a rock formation. A three pronged approach was used to determine the composition of, and geochemical controls, on groundwaters specifically within shale formations: (1) available data were collected from the literature, the US Geological Survey WATSTORE data base, and field sampling, (2) the geochemical modeling code EQ3/6 was used to simulate interaction of various shales and groundwaters, and (3) several types of shale were reacted with synthetic groundwaters in the laboratory. The comparison of model results to field and laboratory data provide a means of validating the models, as well as a means of deconvoluting complex field interactions. Results suggest that groundwaters in shales have a wide range in composition and are primarily of the Na-Cl-HCO_3- type. The constancy of the Na:Cl (molar) ratio at 1:1 and the Ca:Mg ratio from 3:1 to 1:1 suggests the importance of halite and carbonates in controlling groundwater compositions. In agreement with the reaction path modeling, most of the groundwaters are neutral to slightly alkaline at low temperatures. Model and experimental results suggest that reaction (1) at elevated temperatures, or (2) in the presence of oxygen will lead to more acidic conditions. Some acetate was found to be produced in the experiments; depending on the constraints applied, large amounts of acetate were produced in the model results. 13 refs., 1 tab.

38139 (DOE/EIS–0113-Vol.1-Final) **Disposal of Hanford defense high-level, transuranic and tank wastes, Hanford Site, Richland, Washington: Final Environmental Impact Statement: Volume 1.** USDOE Assistant Secretary for Defense Programs, Washington, DC (USA). Dec 1987. 397p. Sponsored by DOE Defense Programs. Order Number DE89013905/JAW. Available from NTIS, PC A17/MF A01 - OSTI; GPO Dep.

The purpose of this Environmental Impact Statement (EIS) is to provide environmental input into the selection and implementation if final disposal actions for high-level, transuranic and tank wastes located at the Hanford Site, Richland, Washington, and into the construction, operation and decommissioning of waste alternatives. Specifically evaluated are a Hanford Waste Vitrification Plant, Transportable Grout Facility, and a Waste Receiving and Packaging Facility. Also an evaluation is presented to assist in determining whether any additional action should be taken in terms of long-term environmental protection for waste that was disposed of at Hanford prior to 1970 as low-level waste (before the transuranic waste category was established by the Atomic Energy Commission but which might fall into that category if generated today).

38140 (DOE/EIS–0113-Vol.2-Final) **Disposal of Hanford defense high-level, transuranic and tank wastes, Hanford Site, Richland, Washington: Final Environmental Impact Statement: Volume 2, Appendices A–L.** USDOE Assistant Secretary for Defense Programs, Washington, DC (USA). Dec 1987. 356p. Sponsored by DOE Defense Programs. Order Number DE89013904/JAW. Available from NTIS, PC A16/MF A01 - OSTI; GPO Dep.

The purpose of this Environmental Impact Statement (EIS) is to provide environmental input into the selection and implementation of final disposal actions for high-level, transuranic and tank wastes located at the Hanford Site, Richland, Washington, and into the construction, operation and decommissioning of waste treatment facilities that may be required in implementing waste disposal alternatives. Specifically evaluated are a Hanford Waste Vitrification Plant Transportable Grout Facility, and a Waste Receiving and Packaging Facility. Also an evaluation is presented to assist in determining whether any additional action should be taken in terms of long-term environmental protection for waste that was disposed of at Hanford prior to 1970 as low-level waste (before the transuranic waste category was established by the Atomic Energy Commission but which might fall into that category if generated today). Volume 2 contains Appendices A through L.

38141 (DOE/EIS–0113-Vol.3-Final) **Disposal of Hanford defense high-level, transuranic and tank wastes, Hanford Site, Richland, Washington: Final Environmental Impact Statement: Volume 3, Appendices M–V.** USDOE Assistant Secretary for Defense Programs, Washington, DC (USA). Dec 1987. 412p. Sponsored by DOE Defense Programs. Order Number DE89013903/JAW. Available from NTIS, PC A18/MF A01 - OSTI; GPO Dep.

The purpose of this Environmental Impact Statement (EIS) is to provide environmental input into the selection and implementation of final disposal actions for high-level, transuranic and tank wastes located at the Hanford Site, Richland, Washington, and into the construction, operation and decommissioning of waste treatment facilities that may be required in implementing waste disposal alternatives. Specifically evaluated are a Hanford Waste Vitrification Plant Transportable Grout Facility, and a Waste Receiving and Packaging Facility. Also an evaluation is presented to assist in determining whether any additional action should be taken in terms of long-term environmental protection for waste that was disposed of at Hanford prior to 1970 as low-level waste (before the transuranic waste category was established by the Atomic Energy Commission but which might fall into that category if generated today). Volume 3 contains appendices M through V.

38142 (DOE/EIS–0113-Vol.4-Final) **Disposal of Hanford defense high-level, transuranic and tank wastes, Hanford Site, Richland, Washington: Final Environmental Impact Statement: Volume 4, Public comments and responses.** USDOE Assistant Secretary for Defense Programs, Washington, DC (USA). Dec 1987. 377p. Sponsored by DOE Defense Programs. Order Number DE89013902/JAW. Available from NTIS, PC A17/MF A01 - OSTI; GPO Dep.

The purpose of this Environmental Impact Statement (EIS) is to provide environmental input into the selection and implementation of final disposal actions for high-level, transuranic and tank wastes located at the Hanford Site, Richland, Washington, and into the construction, operation and decommissioning of waste treatment facilities that may be required in implementing waste disposal alternatives. Specifically evaluated are a Hanford Waste Vitrification Plant, Transportable Grout Facility, and a Waste Receiving and Packaging Facility. Also an evaluation is presented to assist in determining whether an additional action should be taken in terms of long-term environmental protection for waste that was disposed of

at Hanford prior to 1970 as low-level waste (before the transuranic waste category was established by the Atomic Energy Commission but which might fall into that category if generated today). Volume 4 contains public comments and responses.

38143 (DOE/EIS–0113-Vol.5-Final) **Disposal of Hanford defense high-level, transuranic and tank wastes, Hanford Site, Richland Washington: Final Environmental Impact Statement: Volume 5, Public comments.** USDOE Assistant Secretary for Defense Programs, Washington, DC (USA). Dec 1987. 699p. Sponsored by DOE Defense Programs. Order Number DE89013901/JAW. Available from NTIS, PC A99/MF A01 - OSTI.

The purpose of this Environmental Impact Statement (EIS) is to provide environmental input into the selection and implementation of final disposal actions for high-level, transuranic and tank wastes located at the Hanford Site, Richland, Washington, and into the construction, operation and decommissioning of waste treatment facilities that may be required in implementing waste disposal alternatives. Specifically evaluated are a Hanford Waste Vitrification Plant, Transportable Grout Facility, and a Waste Receiving and Packaging Facility. Also an evaluation is presented to assist in determining whether any additional action should be taken in terms of long-term environmental protection for waste that was disposed of at Hanford prior to 1970 as low-level waste (before the transuranic waste category was established by the Atomic Energy Commission but which might fall into that category if generated today). Volume 5 contains public comments.

38144 (DOE/HWP–84) **HAZWRAP research, development and demonstration program, FY 1989.** Oak Ridge National Lab., TN (USA). Mar 1989. 95p. Sponsored by DOE Defense Programs. DOE Contract AC05-84OR21400. (ORNL/M–873). Order Number DE89015513/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The objective of this program is to promote and expedite R&D of important new technologies for application in the elimination, minimization, destruction, stabilization, or delisting of hazardous and mixed wastes resulting from DOE-DP facilities. These high-impact, high-potential technologies are pursued in the private and public sectors with the goal of developing more environmentally acceptable and more economical waste management options. It is a priority of the program to develop cooperative efforts with others where practical. The technologies pursued address conditions and processes regulated by RCRA, CERCLA, and SARA. The scope of the program includes all DOE-DP hazardous and mixed waste management activities that are regulated by RCRA, CERCLA, and/or SARA. The program seeks to focus on waste issues that are significant on the global DP scale. Technology solutions are sought in all areas of the scientific and engineering community. Other government agencies, private and public institutions, and industry, both domestic and foreign, are potential sources for technological solutions.

38145 (DOE/RW–0212) **Licensing Support System: Preliminary Needs Analysis: Volume 1.** USDOE Office of Civilian Radioactive Waste Management, Washington, DC (USA). Jan 1989. 57p. Sponsored by DOE Radioactive Waste Management. Available from OSTI.

This is the first in a series of four reports on the Licensing Support System (LSS) prepared by the DOE Office of Civilian Radioactive Waste Management (OCRWM) for the Office of Management and Budget (OMB). The LSS is an information management system intended to support the needs of all the parties involved in repository licensing, including the Department of Energy (DOE) and the Nuclear Regulatory Commission (NRC). The reports in this series are: Preliminary Needs Analysis, Preliminary Data Scope Analysis, Conceptual Design Analysis, and Benefit-Cost Analysis. The Preliminary Needs Analysis, presented in this report, and the Preliminary Data Scope constitute the system requirements basis for developing a conceptual LSS design, which will be presented in the third report. The Benefit-Cost Analysis evaluated alternatives within this conceptual design. These four reports, and subsequent refinements, are intended to provide the basis for determining the LSS design specifications. 14 refs., 2 figs., 1 tab.

38146 (DOE/WIPP–88-025) **Operational environmental monitoring plan for the waste isolation pilot plant.** Mercer, D.D.; Baker, P.L.; Cockman, J.S.; Fischer, N.T.; Flynn, D.T.; Harvill, J.P.; Knudtsen K.L.; Louderbough, E.T. Westinghouse Electric Corp., Carlsbad, NM (USA). Waste Isolation Div. [1989]. 325p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC04-86AL31950. Order Number DE89014885/JAW. Available from NTIS, PC A14/MF A01 - OSTI; GPO Dep.

This plan defines the scope and extent of the WIPP effluent and environmental monitoring programs during the facility's operational life. It also discusses the quality assurance/quality control programs which ensure that samples collected and the resulting analytical data are representative of actual conditions at the WIPP site. This plan provides a comprehensive description of environmental activities at WIPP, including: a summary of environmental program information, including an update of the status of environmental permits and compliance activities; a description of the WIPP project and its mission; a description of the local environment, including demographics; a summary of applicable standards and regulatory requirements and brief discussions of potential exposure pathways, routine and accidental releases, and their consequences; a summary of the preoperational environmental monitoring and assessment activities and responses to the requirements (Appendix A) and guidelines presented in the "Radiological Effluent Monitoring and Environmental Surveillance for US DOE Operations." 166 refs., 28 figs., 27 tabs.

38147 (DOE/WIPP–88-029) **Determination of WIPP management and institutional requirements document for CH [contact-handled] systems.** Westinghouse Electric Corp., Carlsbad, NM (USA). Waste Isolation Div. Jan 1989. 50p. Sponsored by DOE Defense Programs. DOE Contract AC04-86AL31950. Order Number DE89013214/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This document lists the requirements documents applicable to the receipt of contact-handled (CH) waste at the Waste Isolation Pilot Plant (WIPP). It also describes the processes which were used to determine the applicability of each document. There were 32 documents screened for applicability; 88 were fund to be applicable. The reasons for nonapplicability of critical systems for the receipt of CH wastes were identified and presented.

38148 (DOE/WIPP–88-031) **Critical/non-critical system methodology report.** USDOE Albuquerque Operations Office, NM (USA). Waste Isolation Pilot Plant Project Office. Jan 1989. 50p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC04-86AL31950. Order Number DE89015457/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The method used to determine how the waste Isolation Pilot Plant (WIPP) facilities/systems were classified as critical or non-critical to the receipt of CH waste is described within this report. All WIPP critical facilities/systems are listed in the Operational Readiness Review Dictionary. Using the Final Safety Analysis Report (FSAR) as a guide to define the boundaries of the facilities/systems, a direct correlation of the ORR Dictionary to the FSAR can be obtained. The critical facilities/systems are those which are directly related to or have a critical support role in the receipt of CH waste. The facility/systems must meet one of the following requirements to be considered critical: (a) confinement or measure of the release of radioactive materials; (b) continued receipt and/or storage of transuranic waste (TRU) without an interruption greater than one month according to the shipping plan schedule; (c) the environmental and occupational safety of personnel meets the established site programs; and (d) the physical security of the WIPP facilities.

38149 (DOE/WIPP–89/005) **Annual site environmental report for the Waste Isolation Pilot Plant: Calendar Year 1988.** Cockman, J.S.; Fischer, N.T.; Flynn, D.T.; Harvill, J.P.; Louderbough, E.T.; Lyon, M.L.; Rodriquez, A.L.; Sladek, B.A. Westinghouse Electric Corp., Carlsbad, NM (USA). Waste Isolation Div. [1989]. 185p. Sponsored by DOE Defense Programs. DOE Contract AC04-86AL31950. Order Number DE89012965/JAW. Available from NTIS, PC A09/MF A01 - OSTI; GPO Dep.

This is the fourth annual preoperational Site Environmental Report for the Waste Isolation Pilot Plant (WIPP) in southeastern New Mexico. The purpose of the WIPP is to provide a research and development facility to demonstrate the safe disposal of transuranic (TRU) wastes generated by the defense activities of the US government. This document is prepared in accordance with the guidance

which requires DOE facilities to "submit an Annual Site Environmental Report to the Office of Operational Safety."The report provides a comprehensive description of environmental activities at the WIPP during calendar year 1988, including a description of the WTPP project and its mission; a description of the local environment, including demographics; a summary of environmental program information, including an update of the status of environmental permits and compliance activities; a presentation of the data of the Radiological Baseline Program (RBP), which is a program to characterize background radionuclide concentrations in the environment round the WIPP site; and a summary of findings of the Ecological Monitoring Program (EMP), which examines nonradiological impacts of WIPP construction on the surrounding ecosystem. 48 refs., 41 figs., 32 tabs.

38150 (DOE/WIPP–207-Rev.1) **Construction quality assurance program plan for the WIPP project, Carlsbad, NM: Revision 1.** Westinghouse Electric Corp., Carlsbad, NM (USA). Waste Isolation Div. May 1987. 25p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC04-86AL31950. Order Number DE89015454/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The purpose of this plan is to describe the Quality Assurance (QA) Program to be established and implemented by the US Department of Energy (DOE) Waste Isolation Pilot Plant (WIPP) Project Office (WPO) and by the Major Project Participants: the Architect-Engineer (Bechtel), the Construction Manager (US Army Corps of Engineers), the Scientific Advisor (Sandia National Laboratory), and the Management and Operating Contractor (Westinghouse Electric Corporation). This plan addresses the construction, including site evaluation, design, and turnover phases of WIPP. Other work in progress during the same period is controlled by DOE documents applicable to that work effort. The prime responsibility for ensuring the quality of construction rests with the DOE WIPP Project Office and is implemented through the combined efforts of the Construction Manager, the Construction Contractors, the Management and Operating Contractor, and the Architect-Engineer. Inspection and burden of proof of acceptability rests with the Construction Contractor as defined by the technical provisions of the contract and as otherwise specified by the DOE WIPP Project Office on an individual work-package basis. To the maximum extent possible, acceptance of work will be based upon first-hand witnessing by the Construction Manager and other representatives of the DOE organization.

38151 (DP-MS–88-187) **A multi-detector (NaI) system for nuclear safety in a plutonium processing facility.** Hochel, R.C. Westinghouse Savannah River Co., Aiken, SC (USA). 1989. 6p. Sponsored by DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-890736–37: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, FL, USA, 9-12 Jul 1989). Order Number DE89014147/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A multi-input system using standard commercially available NaI(T1) detectors, electronics, and an MCA was developed to improve nuclear safety in the plutonium processing facility of the Savannah River Plant. Detectors are positioned to nonintrusively measure gamma-ray spectra of a number of process tanks continuously. Based on an MCA analysis of the 330-420 keV complex from Pu-239, an analog signal, proportional to the plutonium concentration, is sent to a strip-chart recorder for tracking, alarm functions, and interlocking of certain process equipment. A computer is used to scale all measurements to user-defined limits, and to perform continuous diagnostic checks to ensure proper calibration and performance of each monitor. In place, but normally not used, are an SCA and ratemeter for each detector, so that in the event of an MCA or computer failure, monitoring functions can be maintained. The system was designed with expansion in mind and has had additional monitors added three times during its four years of very reliable operation. 5 figs.

38152 (DP-MS–89-13) **On-line nuclear material analyzer system for process streams.** Salaymeh, S.R. Westinghouse Savannah River Co., Aiken, SC (USA). 1989. 6p. Sponsored by DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-890736–39: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, FL, USA, 9-12 Jul 1989). Order Number DE89014151/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Analytical Development Division at the Savannah River Site has developed an online radionuclide analyzer system for the evaporator overheads in H-Canyon. The analyzer system consists of two components: an improved online alpha monitor (OLAM-100S), and a sodium iodide gamma detector. The OLAM-100S was developed in our laboratories for monitoring alpha activity in aqueous streams. The gamma analyzer is a commercially available 2" × 2" NaI crystal. An easy-to-install sampler interface couples the analyzer with the sample stream. A degasser is used to provide an air free stream which flows through two sample cells connected in series. The flow cell, detectors, and necessary shielding for the analyzer are housed in a Lexan® box attached to the existing sampler. A prototype system was set up and tested in our analyzer development and demonstration facility. The first analyzer of this type is scheduled for installation in the H-Canyon evaporator overhead streams. The system will have numerous applications plantwide. 4 refs., 4 figs.

38153 (DP-MS–89-45) **Tank calibration problems.** Weber, J.H.; Shine, E.P.; Beckworth, C.M. Westinghouse Savannah River Co., Aiken, SC (USA). 1989. 8p. Sponsored by DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-890736–38: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, FL, USA, 9-12 Jul 1989). Order Number DE89014150/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

With the startup of a new facility and additions to another facility, a number of new tanks were calibrated. The calibration process could not be automated and required manual collection of the data. Several problems were encountered during the calibrations resulting in poor data and problems in estimating the calibration equations due to excessive variability both within a calibration run and between calibration runs. Because of the problems encountered, several tanks had to be recalibrated. The results of both good and poor calibration runs are presented. The poor results were due to several causes, including poor procedures, incomplete data collection, and creative implementation of the procedures. The results demonstrate how the residuals or lack of fit of the model can be used to identify problems. As a result of the problems, a checklist was developed as a guide in writing calibration procedures to ensure all the necessary data are collected and recorded accurately, the procedures are followed as written, and the appropriate personnel approve the procedures. The checklist is used as a supplement to the ANSI tank calibration standard. 7 figs.

38154 (DP-MS–89-61) **Sludge suspension in waste storage tanks.** Hamm, B.A.; West, W.L.; Tatterson, G.B. Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab. 1989. 25p. Sponsored by DOE Defense Programs. DOE Contract AC09-76SR00001. (CONF-890817–2: 12. biennial conference on mixing, Potosi, MO (USA), 6-11 Aug 1989). Order Number DE89014139/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

One of the process objectives in waste processing is to provide Defense Waste Processing Facility (DWPF) a uniform slurry composition at 13 wt % consistently over an extended period of time, i.e., one year. In preparation of the sludge for slurrying to DWPF, several questions have arose with regard to sludge suspension and mixing of solid suspension in the bulk of the tank: How much time is required to prepare a 13 wt % slurry for DWPF? How long will it take to suspend completely the sludge in any particular waste tank? How is slurry weight percent related to cleaning radius? The objective of this study was to answer these questions. 6 figs.

38155 (EGG-M–08487) **Radioactive waste management criteria in fusion reactor materials selection.** Herring, J.S.; Fetter, S. EG and G Idaho, Inc., Idaho Falls, ID (USA). 1987. 17p. Sponsored by DOE Nuclear Energy. DOE Contract AC07-76ID01570. (CONF-871036–38: 3. international conference on fusion reactor materials (ICFRM-3), Karlsruhe, Germany, F.R., 4-8 Oct 1987). Order Number DE89010999/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Fusion reactors will have to meet both quantitative and qualitative criteria for the disposal and/or reuse of radioactive materials. The

most important quantitative criteria presently govern the near-surface disposal of radioactive wastes in the United States. This paper discusses the elemental concentration limits for first wall materials if they are to be acceptable as low-level waste. Qualitative comparisons readily understood by the public, such as the volumes of waste generated or the robustness of the waste form, could in the end be more important to the public acceptance of fusion than comparisons of Curies or man-rems. The second part of the paper discusses methods now in use for reducing low level waste volumes and mobility that could be applied to fusion waste. 10 refs., 2 figs., 4 tabs.

38156 (EUR–11454) **Hydrodynamic dispersion in a single fracture: final report on CRNL experiment.** Lever, D.A.; Evans, G.V.; Novakowski, K.S.; Raven, K.G. Commission of the European Communities, Luxembourg (Luxembourg). 1988. 32p. Available from NTIS (US Sales Only), PC A03/MF A01.

One of the options under consideration for the safe long-term disposal of radioactive waste is deep burial in stable fractured rock formations. The most probable way by which radionuclides from the waste could return to the biosphere is by leaching and dissolution of the waste-form, and then water-borne transport by the ground water. In-situ tracer experiments are an important element in developing an understanding of the physical processes that determine the migration of radionuclides through the rock. Unfortunately, there are few field studies presented in the literature to date, which corroborate existing laboratory studies and provide data for theoretical models of transport through fractured rock. The objective of this study was to design and conduct a tracer experiment in which a single fracture was isolated and tested under advective flow conditions with a conservative tracer. During the summer of 1983 a joint AECL-CEC field test was carried out at the Chalk River test site in Canada. Two experiments were conducted, using ^{82}Br as the conservative tracer, on a discrete fracture identified by hydraulic interference tests at approximately 100 m depth in moderately-fractured monzonitic gneiss. The selected fracture intersects two boreholes in a relatively horizontal attitude over a distance of about 10 m.

38157 (EUR–11875) **HAW project. Demonstrative disposal of high-level radioactive wastes in the Asse salt mine.** Rothfuchs, T.; Duijves, K.; Stippler, R. Commission of the European Communities, Luxembourg (Luxembourg). 1988. 227p. (In German). Available from NTIS (US Sales Only), PC A11/MF A01.

Since 1968 the GSF has been carrying out research and development programs for the final disposal of high-level radioactive waste (HAW) in salt formations. The heat producing waste has been simulated so far by means of electrical heaters and also cobalt-60-sources. In order to improve the final concept for HAW disposal in salt formations the complete technical system of an underground repository is to be tested in an one-to-one scale test facility. To satisfy the test objectives thirty high radioactive canisters containing the radionuclides Cs-137 and Sr-90 will be emplaced in six boreholes located in two test galleries at the 800 m-level in the Asse salt mine. The duration of testing will be approximately five years. For the handling of the radioactive canisters and their emplacement into the boreholes a system consisting of transportation casks, transportation vehicle, disposal machine, and borehole slider will be developed and tested. The actual scientific investigation program is based on the estimation and observation of the interaction between the radioactive canisters and the rock salt. This program includes measurement of thermally and radiolytically induced water and gas release from the rock salt and the radiolytical decomposition of salt minerals. Also the thermally induced stress and deformation fields in the surrounding rock mass will be investigated carefully. The project is funded by the BMFT and the CEC and carrier out in close co-operation with the Netherlands Energy Research Foundation (ECN).

38158 (EUR–11891) **Chemval project. Comparison of thermodynamic databases used in geochemical modelling.** Chandratillake, M.R.; Newton, G.W.A.; Robinson, V.J. Commission of the European Communities, Luxembourg (Luxembourg). 1988. 77p. Available from NTIS (US Sales Only), PC A05/MF A01.

The following four thermodynamic databases used by European groups for geochemical modelling have been compared: UWIST; AERE, Harwell; CHEMVAL Stage I; EIR. The number of aqueous species and solid species as well as components in each database is listed. There are many cases where numbers in the different databases are not directly comparable and have not been compared here. There are five different reasons why this can occur. In each case these are noted. When numbers are directly comparable, they are not necessarily the same between databases. When differences occur we have highlighted them by marking with those cases where β values differ by between a factor of two and an order of magnitude (or the difference in log β is $\geq$ 0.3 but $\leq$ 1.0) and where the difference in β values is more than an order of magnitude (difference in log β > 1.0). This work is a component of the Chemval/Mirage project, performed within the third CEC R and D programme on radioactive waste management and storage.

38159 (EUR–11927) **Study of the Pasquasia underground cavity.** ENEA, Casaccia; Centro Ricerche Energia. Commission of the European Communities, Luxembourg (Luxembourg). 1988. 99p. (In Italian). Available from NTIS (US Sales Only), PC A05/MF A01.

The reliability of the geological disposal of radioactive wastes have to be verified both by laboratory and on site research, under both surface and underground conditions. The tests carried out under high lithostatic stress can allow extrapolations to be made having absolute value at the depths planned for the construction of the repository. On the area around the Pasquasia mine, a detailed geological mapping (1: 5000 scale) has been carried out. For the purpose of studying the effects induced by the advancement of the excavation's face into the clayey mass and over the cross section of the transversal tunnel, several measurement stations were installed (multibase straingauges, convergency rods, pressure cells, centering and concrete straingauges). Structural observations were made on both the fronts and the walls of the tunnel for the purpose of characterizing the mechanical behaviour of a clayey mass. The 37 cubic blocks, their sides measuring measurement 30cm, along 72 samples collected during the excavation, have been analyzed from different point of view (sedimentological, mineralogical, geochemical, micropaleontological, interstitial water content, thermal properties, etc). After the excavation of the tunnel and the installation of the geotechnical stations, the measurements have been carried on up to March 1987. At this date the work programme has been unfortunately stopped by local authorities unfoundly suspecting Pasquasia mine would be used as waste repository.

38160 (GAO/RCED–88-129) **Nuclear waste.** General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. 1988. 15p. Available from General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

As required by the Nuclear Waste Policy Act of 1982, the Department of Energy is to annually determine whether the waste disposal fee will produce sufficient revenues to offset the total estimated costs of the waste disposal program. In its June 1987 assessment, DOE recommended that the fee remain unchanged even though its analysis showed that at an inflation rate of 4 percent the current fee would result in end-of-program deficits ranging from $21 billion to $76 billion in 2085. The 1988 assessment calls for reduced total costs because of program changes. Thus, DOE may be able to begin using a realistic inflation rate in determining fee adequacy in 1988 without proposing a major fee increase.

38161 (LA–11595-PR) **Laboratory and field studies related to the hydrology/radionuclide migration project: Progress report, October 1, 1987–September 30, 1988.** Thompson, J.L. (comp. and ed.). Los Alamos National Lab., NM (USA). Jul 1989. 29p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-36. Order Number DE89014390/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Our field research is carried out at three different areas of the Nevada Test Site. We continue to monitor the elution of tritium, ^{85}Kr, and fission products from the cavity region at the Cambric site. About 85% of the tritium has been eluted from the RNM-2S well, but no radioactive cations are present in the eluate. The concentrations of tritium, ^{85}Kr, and ^{125}Sb in water samples from the UE20n#1 hole at the Cheshire site are approximately the same as in the U20n hole, but the concentration of ^{137}Cs is appreciably lower. The presence of hydrous ferric oxides in the UE20n#1 water makes sample analyses difficult to interpret. We found the detergent used in drilling UE20n#1 was useful over a wider range of dilutions

than the bromide ion commonly used to trace the drilling fluids. At the study site near U3kz on Yucca Flat, the collapse of drill hole UE3e#3 frustrated our hopes of obtaining a core bearing radioactive material from an adjacent site. We have initiated some studies of activity distribution in a core from a different location, UE4g#2. Laboratory studies of the size/density properties of plutonium(IV) colloids are continuing; our efforts in colloid research will be considerably enhanced by the recent completion of a clean room facility. We are prepared to conduct packer tests at UE4t to measure the hydraulic properties of the pressurized aquifer underlying this part of Yucca Flat. Radioactivity detected during the drilling of the off-site hole PM-3 proved to be from natural sources. A proposed plan for future work at Yucca Flat is included in this report. In the Appendix we list other project activities to which we contributed during the past year. 18 refs., 4 figs., 5 tabs.

38162 (LBL–27156) **Letter report (T-418): Progress report on solubility measurements, October 1, 1987–September 30, 1988.** Nitsche, H. Lawrence Berkeley Lab., CA (USA). 21 Mar 1989. 16p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC03-76SF00098. Order Number DE89014889/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

NThis letter report describes the technical activities of the waste element solubility study during Fiscal Year (FY88, October 1, 1987 to September 30, 1988). This experimental waste element solubility study provides experimentally determined limits on radionuclide concentrations in groundwater from Yucca Mountain. Furthermore, the results of this study are essential for verifying the validity of radionuclide transport calculations, and for providing the maximum concentrations for the radionuclide sorption tests. Solubility is the source term for radionuclide transport calculations. The solubility in this study is controlled by fewer variables than are used in the multiparameter transport model. Therefore, modeling must be capable of predicting the results of this waste element solubility study. Agreement between the experimental result and the modeling predictions will validate the geochemical module of the transport model. 3 refs., 8 figs.

38163 (LBL–27157) **Solubility and speciation studies of waste radionuclides pertinent to geologic disposal at Yucca Mountain: Results on neptunium, plutonium and americium in J-13 groundwater: Letter report (R707): Reporting period, October 1, 1985–September 30, 1987.** Nitsche, H.; Standifer, E.M.; Lee, S.C.; Gatti, R.C.; Tucker, D.B. Lawrence Berkeley Lab., CA (USA). Jan 1988. 70p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC03-76SF00098. Order Number DE89014896/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

We have studied the solubilities of neptunium, plutonium, and americium in J-13 groundwater from Yucca Mountain (Nevada) at three temperatures and hydrogen ion concentrations. They are 25°, 60°C, and 90°C and pH 5.9, 7.0, and 8.5. The results for 25°C are from a study which we did during FY 1984. We included these previous results in the tables to give more information on the solubility temperature dependence; they were, however, done at only one pH (7.0). The solubilities were studied from oversaturation. The nuclides were added at the beginning of each experiment as NpO_2^+, Pu^{4+}, and Am^{3+}. The neptunium solubility decreased with increasing temperature and with increasing pH. The soluble neptunium did not change oxidation state at steady state. The pentavalent neptunium was increasingly complexed by carbonate with increasing pH. All solids were crystalline and contained carbonate, except the solid formed at 90°C and pH 5.9. We identified this solid as crystalline Np_2P_5. The 25°C, pH 7 solid was $Na_3NpO_2(CO_3)_2 \cdot nH_2O$. Plutonium concentrations decreased with increasing temperature and showed no trend with pH. Pu(V) and Pu(VI) were the dominant oxidation states in the supernatant solution; as the amount of Pu(V) increased with pH, Pu(VI) decreed. The steady-state solids were mostly amorphous, although some contained a crystalline component. They contained Pu(IV) polymer and unknown carbonates.

38164 (LBL–27179) **Spatial statistics for predicting flow through a rock fracture.** Coakley, K.J. Lawrence Berkeley Lab., CA (USA). Mar 1989. 203p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC03-76SF00098. Order Number DE89015444/JAW. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

Fluid flow through a single rock fracture depends on the shape of the space between the upper and lower pieces of rock which define the fracture. In this thesis, the normalized flow through a fracture, i.e. the equivalent permeability of a fracture, is predicted in terms of spatial statistics computed from the arrangement of voids, i.e. open spaces, and contact areas within the fracture. Patterns of voids and contact areas, with complexity typical of experimental data, are simulated by clipping a correlated Gaussian process defined on a N by N pixel square region. The voids have constant aperture; the distance between the upper and lower surfaces which define the fracture is either zero or a constant. Local flow is assumed to be proportional to local aperture cubed times local pressure gradient. The flow through a pattern of voids and contact areas is solved using a finite-difference method. After solving for the flow through simulated 10 by 10 by 30 pixel patterns of voids and contact areas, a model to predict equivalent permeability is developed. The first model is for patterns with 80% voids where all voids have the same aperture. The equivalent permeability of a pattern is predicted in terms of spatial statistics computed from the arrangement of voids and contact areas within the pattern. Four spatial statistics are examined. The change point statistic measures how often adjacent pixel alternate from void to contact area (or vice versa) in the rows of the patterns which are parallel to the overall flow direction. 37 refs., 66 figs., 41 tabs.

38165 (NUREG/CR–3964-Vol.1) **Techniques for determining probabilities of events and processes affecting the performance of geologic repositories: Literature review.** Hunter, R.L.; Mann, C.J. (eds.). Nuclear Regulatory Commission, Washington, DC (USA). Div. of High-Level Waste Management; Sandia National Labs., Albuquerque, NM (USA). Jun 1989. 170p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (SAND–86-0196-Vol.1). Available from NTIS, PC A09/MF A01 - GPO - OSTI.

The US Environmental Protection Agency (EPA) has set a probabilistic standard for the performance of geologic repositories for the disposal of radioactive waste. This report treats not only geologic events and processes like fault movement, but also events and processes that arise from the relationship between human actions and geology, like drilling for resources, and some that arise from nongeologic processes that in turn affect a geologic process, like climatic change. It reviews the literature in several fields to determine whether existing probabilistic methods for predicting events and processes are adequate for implementation of the standard. Techniques exist for qualitatively estimating the potential for endowment of portions of earth's crust with mineral resources, but such techniques cannot easily predict whether or not human intrusion will occur. The EPA standard offers explicit guidance for the treatment of human intrusion, however. A complete method for climatic prediction could be assembled from existing techniques, although such a combination has not been tested. Existing techniques to support a probabilistic assessment of tectonic activity and seismic hazard at a repository site should be combined with expert judgment in performance assessments. Depending on the regional setting, either analytic techniques or expert judgment may be appropriate in assigning probabilities to volcanic activity. The individual chapters of this report have been cataloged separately.

38166 (NUREG/CR–5402) **Crushed salt consolidation.** Ouyang, S.; Daemen, J.J.K. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Arizona Univ., Tucson, AZ (USA). Dept. of Mining and Geological Engineering. Jul 1989. 110p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A06/MF A01 - GPO - OSTI.

The objective of this study is to investigate the time-dependent consolidation of confined crushed salt under axial loading. The crushed salt is geometrically characterized in terms of its grain size distribution and by means of particle shape determinations. Crushed salt of a selected grain size distribution is emplaced in a steel cylinder, and an axial load is applied to the salt. The deformation is monitored. The axial load is increased in steps. Results are presented as void ratio vs time curves, for the various applied stresses. Air dried samples have a brine content of 0.2%; moistened samples

have a brine content ranging from 1.75 to 8.8%. The general consolidation trend can be represented as a linear function of the logarithm of time, but with noticeable temporary accelerations. Consolidation time calculations, predicted from the results of fitted curve parameters, admittedly extrapolated far beyond the measurement range, indicate that reconsolidation of the materials as emplaced and tested here would require many centuries. It deserves emphasis that these experiments were initiated on a extremely loose crushed salt fill. Consolidation rate increases with brine content. The dependency upon applied stress remains ambiguous. The obtained void reduction rates are significantly lower than published results determined from isostatic consolidation. Given the small number of tests completed, all results and conclusions must be considered preliminary. Tests in configurations that may be representative for expected in-situ consolidation conditions are recommended. 102 refs., 41 figs., 11 tabs.

38167 (PNL–6616) **Gravel admix, vegetation, and soil water interactions in protective barriers: Experimental design, construction, and initial conditions.** Waugh, W.J. Pacific Northwest Lab., Richland, WA (USA). May 1989. 80p. Sponsored by DOE Defense Programs. DOE Contract AC06-76RL01830. Order Number DE89014384/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The purpose of this study is to measure the interactive effects of gravel admix and greater precipitation on soil water storage and plant abundance. The study is one of many tasks in the Protective Barrier Development Program for the disposal of Hanford defense waste. A factorial field-plot experiment was set up at the site selected as the borrow area for barrier topsoil. Gravel admix, vegetation, and enhanced precipitation treatments were randomly assigned to the plots using a split-split plot design structure. Changes in soil water storage and plant cover were monitored using neutron probe and point intercept methods, respectively. The first-year results suggest that water extraction by plants will offset gravel-caused increases in soil water storage. Near-surface soil water contents were much lower in graveled plots with plants than in nongraveled plots without plants. Large inherent variability in deep soil water storage masked any effects gravel may have had on water content below the root zone. In the future, this source of variation will be removed by differencing monthly data series and testing for changes in soil water storage. Tests of the effects of greater precipitation on soil water storage were inconclusive. A telling test will be possible in the spring of 1988, following the first wet season during which normal precipitation is doubled. 26 refs., 9 figs., 9 tabs.

38168 (PNL–6840) **Field study plan for alternate barriers.** Freeman, H.D.; Gee, G.W.; Relyea, J.F. Pacific Northwest Lab., Richland, WA (USA). May 1989. 42p. Sponsored by DOE Nuclear Energy. DOE Contract AC06-76RL01830. Order Number DE89014964/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Pacific Northwest Laboratory (PNL) is providing technical assistance in selecting, designing, evaluating, and demonstrating protective barriers. As part of this technical assistance effort, asphalt, clay, and chemical grout will be evaluated for use as alternate barriers. The purpose of the subsurface layer is to reduce the likelihood that extreme events (i.e., 100-year maximum storms, etc.) will cause significant drainage through the barrier. The tests on alternate barriers will include laboratory and field analysis of the subsurface layer performance. This field test plan outlines the activities required to test and design subsurface moisture barriers. The test plan covers activities completed in FY 1988 and planned through FY 1992 and includes a field-scale test of one or more of the alternate barriers to demonstrate full-scale application techniques and to provide performance data on a larger scale. Tests on asphalt, clay, and chemical grout were initiated in FY 1988 in small (30.5 cm diameter) tube-layer lysimeters. The parameters used for testing the materials were different for each one. The tests had to take into account the differences in material characteristics and response to change in conditions, as well as information provided by previous studies. 33 refs., 8 figs., 1 tab.

38169 (PNL–6957) **Resource conservation and recovery act ground-water monitoring projects for Hanford facilities: Progress report, January 1–March 31, 1989.** Smith, R.M.; Bates, D.J.; Lundgren, R.E. Pacific Northwest Lab., Richland, WA (USA). Jun 1989. 252p. Sponsored by DOE Nuclear Energy. DOE Contract AC06-76RL01830. Order Number DE89014972/JAW. Available from NTIS, PC A11/MF A01 - OSTI.

This document describes the progress of 13 Hanford Site groundwater monitoring projects for the period January 1 to March 31, 1989. The work described in this document is conducted by the Pacific Northwest Laboratory under the management of Westinghouse Hanford Company for the US Department of Energy. Concentrations of ground-water constituents are compared to federal drinking water standards throughout this document for reference purposes. All drinking water supplied from the sampled aquifer meets regulatory standards for drinking water quality. 32 refs., 30 figs., 103 tabs.

38170 (PNL-SA–16234) **LWR spent fuel storage technology: Advances and experience.** Gilbert, E.R.; Bailey, W.J.; Johnson, A.B. Jr.; McKinnon, M.A. Pacific Northwest Lab., Richland, WA (USA). 1989. 6p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC06-76RL01830. (CONF-8903112–3: Waste management '89, Tucson, AZ, USA, 1 Mar 1989). Order Number DE89014930/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

By 2003, the year the US Department of Energy (DOE) currently predicts a repository will be available, 58 domestic commercial nuclear-power plant units are expected to run out of wet storage space for LWR spent fuel. To alleviate this problem, utilities implemented advances in storage methods that increased storage capacity as well as reduced the rate of generating spent fuel. Those advances include (1) transhipping spent-fuel assemblies between pools within the same utility system, (2) reracking pools to accommodate additional spent-fuel assemblies, (3) taking credit for fuel burnup in pool storage rack designs, (4) extending fuel burnup, (5) rod consolidation, and (6) dry storage. The focus of this paper is on advances in rod consolidation and dry storage. Wet storage continues to be the predominant US spent-fuel management technology, but as a measure to enhance at-reactor storage capacity, the Nuclear Waste Policy Act of 1982 authorized DOE to assist utilities with licensing at-reactor dry storage. Information exchanges with other nations, laboratory testing and modeling, and cask tests cooperatively funded by US utilities and DOE produced a strong technical basis to develop confidence that LWR spent fuel can be stored safely for several decades in both wet and dry modes. Licensed dry storage of spent fuel in an inert atmosphere was first achieved in the US in 1986. Studies are underway in several countries to determine acceptable conditions for storing LWR spent fuel in air. Rod-consolidation technology is being developed and demonstrated to enhance the capacity for both wet and dry storage. Large-scale commercial implementation is awaiting optimization of practical and economical mechanical systems. 22 refs., 1 fig.

38171 (PNL-SA–16584) **In situ vitrification: Test results for a contaminated soil melting process.** Buelt, J.L.; Bonner, W.F. Pacific Northwest Lab., Richland, WA (USA). Apr 1989. 8p. Sponsored by DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-890521–11: 8. international conference on thermal destruction of hazardous, radioactive, infectious and mixed wastes, Knoxville, TN, USA, 1-5 May 1989). Order Number DE89014459/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Pacific Northwest Laboratory (PNL) is developing in situ vitrification (ISV), a remedial action process for treating contaminated soils. In situ vitrification is a thermal treatment process that converts contaminated soil into a chemically inert and stable glass and crystalline product. Figure 1 depicts the process. A square array of four molybdenum/graphite electrodes is inserted into the ground to the desired treatment depth. Because soil is not electrically conductive when the moisture has been driven off, a conductive mixture of flaked graphite and glass frit is placed between the pairs of electrodes as a starter path. An electrical potential is applied to the electrodes to establish an electric current in the starter path. The resultant power heats the starter path and surrounding soil to 2000°C, well above the initial soil-melting temperature of 1100 to 1400°C. The graphite starter path is eventually consumed by oxidation, and the current is transferred to the molten soil, which is electrically conductive. As the molten or vitrified zone grows, it incorporates radionuclides and nonvolatile hazardous elements, such

as heavy metals, and destroys organic components by pyrolysis. The pyrolyzed byproducts migrate to the surface of the vitrified zone, where they burn in the presence of oxygen. A hood placed over the area being vitrified directs the gaseous effluents to an off-gas treatment system. 5 refs., 1 fig., 1 tab.

38172 (SAND–87-1433) **G-Tunnel Welded Tuff Mining experiment evaluations.** Zimmerman, R.M.; Bellman, R.A. Jr.; Mann, K.L.; Zerga, D.P.; Fowler, M.; Johnson, J.R. Sandia National Labs., Albuquerque, NM (USA). Dec 1988. 100p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC04-76DP00789. Order Number DE89014378/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Designers and analysts of radioactive waste repositories must be able to predict the mechanical behavior of the host rock. Sandia National Laboratories elected to conduct a mine-by in welded tuff so that predictive-type information could be obtained regarding the response of the rock to a drill and blast excavation process, where smooth blasting techniques were used. This report describes the results of the mining processes and presents and discusses the rock mass responses to the mining and ground support activities. 37 refs., 20 figs., 7 tabs.

38173 (SAND–87-1937C) **Evaluation of site-generated radioactive waste treatment and disposal methods for the Yucca Mountain repository.** Subramanian, C.V.; Jardine, L.J. Sandia National Labs., Livermore, CA (USA). 1989. 9p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC04-76DR00789. (CONF-890855–22: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989). Order Number DE89010742/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This study identifies the sources of radioactive wastes that may be generated at the proposed high level waste (HLW) repository at Yucca Mountain, Nevada, estimates the waste quantities and characteristics, compares various technologies that are available for waste treatment and disposal, and develops recommended concepts for site-generated waste treatment and disposal. The scope of this study is limited to the repository operations during the emplacement phase, in which 70,000 MTU of high-level waste will be received and emplaced at the proposed repository. The evaluations consider all radioactive wastes generated during normal operations in surface and underground facilities. Wastes generated as a result of accidents are not addressed because accidents that could result in large quantities of radioactive waste are expected to occur very infrequently so that temporary, portable systems could be used for cleanup, if necessary. The results of this study can be used to develop more definitive plans for managing the site-generated wastes and to serve as a basis for the design of associated facilities at the proposed repository. 8 refs., 1 tab.

38174 (SAND–88-1931C) **Cost-benefit assessment methodology for seismic design of high-level waste repository facilities.** Subramanian, C.V.; Hadjian, A.H. Sandia National Labs., Livermore, CA (USA). 1989. 8p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DR00789. (CONF-890855–30: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA, USA, 14-18 Aug 1989). Order Number DE89011540/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper summarizes a methodology for performing a cost-benefit assessment of the seismic design of the surface facilities associated with the prospective high-level waste repository at Yucca Mountain, NV. The methodology described will develop the costs and benefits of varying design levels for vibratory ground motion and surface fault displacements for structures, components, and equipment in the repository facilities. 2 refs., 1 fig.

38175 (SAND–88-2486C) **Stability of underground openings in the Yucca Mountain repository.** Blejwas, T.E. Sandia National Labs., Albuquerque, NM (USA). 1989. 9p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC04-76DP00789. (CONF-890855–4: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989). Order Number DE89009378/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The licensing of a repository for high-level radioactive waste will require assurances that underground openings do not experience frequent major instabilities, which are defined here as sudden movements of blocks of rock that limit the functions of the openings. Although the design of nuclear power plant structures is controlled by strict adherence to building or professional-engineering codes, this approach is not practical for the structural design of underground facilities because the design must accommodate a varied and partially defined geologic setting. However, regulations require the reduction of the potential for deleterious rock movement and the design of openings to maintain the option to retrieve waste. The present plans for meeting these requirements for a repository at Yucca Mountain, Nevada, include a program of state-of-the-art analyses and modified forms of existing empirically based design methods. An extensive experimental program is required to provide confidence in the results of the design-analysis process. 7 refs., 1 fig.

38176 (SAND–88-7067C) **A probabilistic estimate of seismic damage to the waste-handling building of a repository located at Yucca Mountain, Nevada.** Kiciman, O.K.; Abrahamson, N.A. Sandia National Labs., Albuquerque, NM (USA). 1989. 12p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890855–31: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989). Order Number DE89011396/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

The waste-handling building (WHB) at the Yucca Mountain repository is a reinforced concrete structure with massive shear walls whose thicknesses are established by shielding requirements. The probabilities of seismic damage to the WHB are calculated in this paper. To determine these probabilities seismic hazard curves for the site and fragility curves for the building were developed and combined. The details of this work are found in SNL (1988). The seismic hazard analysis considers both ground acceleration at the WHB site and vertical ground rupture under the WHB. Standard methods (McGuire, 1976; 1978) were used to estimate the acceleration hazard assuming that there is not ground rupture under the WHB. The ground rupture hazard from unknown faults was estimated using a conservative approach developed in this study. The acceleration hazard associated with ground rupture under the WHB was also computed. 7 refs., 16 figs.

38177 (SAND–88-7070C) **Simulation of a fuel pin impacting a rigid floor during waste-handling operations.** Lee, J.J.; Wu, Ching L. Sandia National Labs., Albuquerque, NM (USA). 1989. 17p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC04-76DP00789. (CONF-890855–46: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989). Order Number DE89014691/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

For the waste-handling operations at the prospective Yucca Mountain repository, a potential fuel assembly drop was investigated to determine the effect of impact on the radioactive material contained in the fuel pins held within the fuel assembly. A typical pressurized water reactor (PWR) fuel assembly was selected for this investigation. The fuel assembly contains 264 fuel pins supported by a grid assembly with sufficient friction forces. The fuel pins do not touch end fittings, but are suspended with a gap of 0.75 in. between the bottom of the fuel pins and the bottom nozzle. 6 refs., 7 figs., 2 tabs.

38178 (SAND–88-7120C) **A proposed concrete shaft liner design method for an underground nuclear waste repository.** Richardson, A.M.; Schmidt, B.; St. John, C.M.; Stinebaugh, R.E. Sandia National Labs., Albuquerque, NM (USA). 1989. 8p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC04-76DP00789. (CONF-890855–47: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA, USA, 14-18 Aug 1989). Order Number DE89014707/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

General requirements and performance objectives for nuclear waste repository shafts (operational safety and waste retrievability) are defined in 10 CFR 60.133 (NRC, 1988). The Generic Requirements Document (DOE, 1986) interprets and expands these requirements into more specific functional requirements for liners of

these shafts, including structural integrity, provisions for attaching shaft fittings, and water control. These requirements also apply to the exploratory shafts used for site characterization because they may later be used in the repository. Cast-in-place concrete liners are excellent for vertical shafts, providing security from rockfalls, convenient attachment of shaft equipment, low resistance to ventilation airflow, and protection of the wall rock from weathering. Concrete-lined shafts are planned for the proposed waste repository in Nevada. To meet repository licensing requirements, a design methodology for liners must be developed that considers the effects of induced thermal and seismic loads on the liner in the context of repository performance requirements. The major steps of a proposed methodology are outlined in this paper. 8 refs., 2 figs.

38179 (SAND–89-1419C) **Application of generic risk assessment software to radioactive waste disposal.** Campbell, J.E.; Longsine, D. Sandia National Labs., Albuquerque, NM (USA). 1989. 17p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890855–49: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989). Order Number DE89013817/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Monte Carlo methods are used in a variety of applications such as risk assessment, probabilistic safety assessment, and reliability analysis. While Monte Carlo methods are simple to use, their application can be laborious. A new microcomputer software package has been developed that substantially reduces the effort requires to conduct Monte Carlo analyses. The Sensitivity and Uncertainty Analysis Shell (SUNS) is a software shell in the sense that a wide variety of application model can be incorporated into it. SUNS offers several useful features including a menu-driven environment, a flexible input editor, both Monte Carlo and Latin Hypercube sampling, the ability to perform both repeated trials and parametric studies in a single run, and both statistical and graphical output. SUNS also performs all required file management functions. 9 refs., 6 figs., 1 tab.

38180 (SAND–89-7003C) **Offsite radiation doses resulting from seismic events at the Yucca Mountain repository.** Ma, C.W.; Jardine, L.J. Sandia National Labs., Albuquerque, NM (USA). 1989. 13p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC04-76DP00789. (CONF-890855–45: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989). Order Number DE89014690/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper describes a preliminary study to evaluate the offsite doses resulting from seismic events postulated to occur during the preclosure period at the proposed Yucca Mountain repository. The work reported here is part of a larger preliminary study of the costs and benefits of designing the waste-handling building (WHB) at the repository for seismic events of varying severity. During an earthquake, the quantity of radiological releases is dependent on the damage state of the structure or facility under construction. For the purpose of this study, four damage states are used: light, moderate, heavy, and total. These damage states are characterized by various degrees of spalling of concrete pieces from the walls and cracking of the walls. The spalling concrete may hit the spent fuel assemblies and cause radiological releases. An estimate of the maximum total radionuclide inventory in the WHB is made in Section 2.0. In Section 3.0, the quantities of radioactive material released for each damage state are evaluated. The offsite doses resulting from these releases are calculated in Section 4.0. Section 5.0 presents the conclusions.

38181 (WHC-EP–0216) **Preliminary operable units designation project.** Westinghouse Hanford Co., Richland, WA (USA). Feb 1989. 229p. Sponsored by DOE Environment Health & Safety. DOE Contract AC06-87RL10930. Order Number DE89013925/JAW. Available from NTIS, PC A11/MF A01 - OSTI; GPO Dep.

The Preliminary Operable Units Designation Project organizes the radioactive, hazardous chemical, and mixed waste management units and the resulting groundwater contamination plumes at the Hanford Site near the city of Richland, Washington, into groups that, due to complementary characteristics, would be amenable to combined characterization and/or remediation. These groups are referred to as operable units. Currently, 78 operable units have been designated and include the over 1,500 waste management units and four groundwater contamination plumes identified on the DOE-owned Hanford Site. The designation of operable units included all individual waste management units identified by the Hanford Waste Information Data System as of February 28, 1989. 5 refs., 9 tabs.

38182 (WHC-EP–0224) **Hanford waste vitrification plant applied technology plan.** Kruger, O.L. Westinghouse Hanford Co., Richland, WA (USA). Jun 1989. 120p. Sponsored by DOE Defense Programs. DOE Contract AC06-87RL10930. Order Number DE89014948/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This Applied Technology Plan describes the waste form development, equipment evaluation and testing, and waste form qualification technical issues and plans for resolution to support the design, permitting, and operation of the Hanford Waste Vitrification Plant (HWVP). The scope of this Plan includes work to be performed by the research and development contractor, Pacific Northwest Laboratory, other organizations within Westinghouse Hanford Company, universities and companies with glass technology expertise, and other US Department of Energy sites. Work to be performed under this Plan is divided into major areas that establish a reference process, develop an acceptable glass composition envelope, and demonstrate feed processing and glass production for the range of HWVP feeds. Included in this work is the evaluation and verification testing of equipment and technology obtained from the Defense Waste Processing Facility, West Valley Demonstration Project, foreign countries, and the Hanford Site. Development and verification of product and process models and other data needed for WFQ documentation are also included in this Plan. All applied technology work has been planned in detail to support the HWVP Project's scheduled design, permitting, and startup activities. Overview and detailed milestone schedules are provided for information and reference. The total estimated cost (in escalated dollars) for applied technology work from fiscal year 1990 through fiscal year 1999 is $121,248,000 expense plus $7,500,000 capital equipment not related to construction. A cost breakdown is given by task and year of expenditure. The above figures are based on "required case" planning to support planned milestones and other activities leading to the December 1999 hot startup of the HWVP. 11 refs., 4 figs., 43 tabs.

38183 (WHC-EP–0250-Vol.2) **Hanford Waste Vitrification Plant Preliminary Safety Analysis Report: Draft.** Herborn, D.I.; Smith, D.A. Westinghouse Hanford Co., Richland, WA (USA). Jul 1989. 375p. Sponsored by DOE Defense Programs. DOE Contract AC06-87RL10930. Order Number DE89015038/JAW. Available from NTIS, PC A16/MF A01 - OSTI.

This document comprises the safety analysis report for the proposed vitrification plant at the Hanford Reservation. Topics discussed in volume 2 include facility design and the associated blueprints. (TEM)

38184 (WHC-EP–0250-Vol.3) **Hanford Waste Vitrification Plant preliminary safety analysis report: Volume 3: Draft.** Herborn, D.I.; Smith, D.A. Westinghouse Hanford Co., Richland, WA (USA). Jul 1989. 387p. Sponsored by DOE Defense Programs. DOE Contract AC06-87RL10930. Order Number DE89015039/JAW. Available from NTIS, PC A17/MF A01 - OSTI; GPO Dep.

This document comprises the safety analysis report for the proposed vitrification plant at the Hanford Reservation. Topics discussed in Volume 3 include process systems and the associated figures. (TEM)

38185 (WHC-EP–0250-Vol.4) **Hanford Waste Vitrification Plant preliminary safety analysis report: Volume 4: Draft.** Herborn, D.I.; Smith, D.A. Westinghouse Hanford Co., Richland, WA (USA). Jul 1989. 585p. Sponsored by DOE Defense Programs. DOE Contract AC06-87RL10930. Order Number DE89015040/JAW. Available from NTIS, PC A25/MF A01 - OSTI; GPO Dep.

This document contains five chapters on activities at the proposed vitrification plant on the Hanford Reservation. Chapter topics include waste confinement and management, health protection, accident safety analysis, operation, operational safety requirements, and quality assurance. (TEM)

38186 (WHC-SA-0199) **Regulatory/permit activities for mixed waste disposal at the Hanford Grout Treatment Facility.** Bostic, O.L.; Guymon, R.H.; Richmond, W.G. Westinghouse Hanford Co., Richland, WA (USA). Jun 1988. 8p. Sponsored by DOE Defense Programs. DOE Contract AC06-87RL10930. (CONF-880903-56: Spectrum '88: international topical meeting on nuclear and hazardous waste management, Pasco, WA, USA, 11-15 Sep 1988). Order Number DE89014957/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper describes how the Grout Treatment Facility (GTF) complies with Resource Conservation and Recovery Act (RCRA) regulations that require consideration of hazardous waste issues in addition to the radiation protection standards. Alternate operating procedures and innovative designs are used to ensure acceptable levels of health and environmental protection. These procedures and designs are detailed in Part B of the permit application prepared for the GTF. 2 tabs.

38187 (WHC-SA-0415) **Model testing conducted to benchmark the Shippingport Reactor Pressure Vessel/Neutron Shield Tank package safety analysis.** Becker, D.L.; Burgess, D.M.; Bowen, W.W.; Winkel, B.V. Westinghouse Hanford Co., Richland, WA (USA). Mar 1989. 9p. Sponsored by DOE Defense Programs. DOE Contract AC06-87RL10930. (CONF-890855-16: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989). Order Number DE89010108/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The decommissioned Shippingport Reactor Pressure Vessel (RPV) and its integral Neutron Shield Tank (NST) were transported from Shippingport, Pennsylvania, via barge to Hanford, Washington for burial in the Hanford Site Radioactive Waste Disposal Area. To ensure that the Reactor Pressure Vessel/Neutron Shield Tank (RPV/NST) assembly could be shipped safely, without undue risk to the public or the environment, the RPV/NST assembly was certified by the US Department of Energy (DOE) as a Type B package. A Safety Analysis Report for Packaging (SARP) was prepared in accordance with DOE requirements to provide the technical basis for the DOE certification. The RPV/NST package is a monolithic structure of lightweight concrete and steel. Its estimated weight is 844 t (930 tons). To substantiate multidimensional inelastic analyses, a series of 11 drop tests were conducted on seven, 1/10 size benchmark models from heights of 30.5 cm (1 ft), 9.14 m (30 ft), and 13.7 m (45 ft). Technical evaluation and correlation of the test data were performed in conjunction with the structural analysis and assessment of the package. These model tests confirmed the predicted analytical results and provided experimental benchmark data to support the material, physical, and mechanical properties and reaction rates used in the analyses. 1 fig., 4 tabs.

38188 (WHC-SA-0567) **Hanford site solid low-level mixed waste program.** Jasen, W.G.; Boynton, H.C.; Anderson, J.D. Westinghouse Hanford Co., Richland, WA (USA). Jun 1989. 21p. Sponsored by DOE Defense Programs. DOE Contract AC06-87RL10930. (CONF-890854-5: 11. annual DOE low level waste management conference, Pittsburgh, PA (USA), 22-24 Aug 1989). Order Number DE89014945/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Solid radioactive wastes have been managed at the Hanford Site since the early 1940's. Initially solid wastes were disposed of through shallow land burial. Later certain wastes were placed in below-grade areas designated as retrievable storage. Currently, contact-handled mixed wastes are placed in above-grade storage facilities. This paper presents a brief description of past, present, and future mixed waste activities at the Hanford Site. 5 refs., 11 figs.

38189 (WINCO-1064) **Corrosion evaluation of ICPP high-level liquid waste storage tanks.** Zimmerman, C.A. Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (USA). Apr 1989. 30p. Sponsored by DOE Nuclear Energy. DOE Contract AC07-84ID12435. Order Number DE89014406/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Corrosion test coupons removed from the high level liquid waste (HLLW) tanks at the Idaho chemical Processing Plant (ICPP) during a 1987-1988 coupon recovery operation have been evaluated. The data indicate that the fluoride containing first cycle raffinates are the most corrosive solutions with an average general corrosion rate of 2.9×10^{-2} mil per year. The average general corrosion rate for non-fluoride first cycle waste solution is 1.3×10^{-2} mil per year. Sodium wastes (principally PEW bottoms) are much less corrosive with an average general corrosion rate of 6.6×10^{-4} mil per year. These corrosion rates indicate a very low general corrosion rate for the internal surfaces of the austenitic stainless steel tanks. The corrosion test coupons in the HLLW vessels at this time do not indicate any localized corrosion such as pitting or heat affected weld zone attack. New coupon assemblies were installed in the HLLW tanks which will be exposed on the bottom of most tanks. 4 refs., 7 figs., 5 tabs.

38190 (WSRC-RP-89-124) **Mixing characterization in a slab tank.** Stoots, C.M.; Gavlak, A.M.; Calabrese, R.V.; Kyser, E.A.; Tatterson, G.B. Westinghouse Savannah River Co., Aiken, SC (USA). 1989. 47p. Sponsored by DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-890817-1-Vugraphs: 12. biennial conference on mixing, Potosi, MO (USA), 6-11 Aug 1989). Order Number DE89013555/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Due to safety requirements, slab tanks are often used to process radioactive materials. The configuration is that of a slit or a tank of rectangular cross section with very low aspect ratio. Due to its non-conventional geometry, very little is known about the slab tank mixing environment. To better understand it, experiments have been performed in a full scale standard configuration equipped with two stirrer shafts, each containing several axial impellers. To characterize the velocity field, mean and RMS turbulent velocities have been measured at several impeller speeds with a two-component Laser Doppler Anemometer (LDA). The LDA data have been supplemented with flow visualization, circulation time, and mixing time studies. Since the slab tank is often used as a precipitator, solids suspension studies have also been performed. The results of the various experiments will be presented and will be interpreted to elucidate slab tank dynamics. The implication to mixing efficiency will also be discussed.

38191 Performance assessment, site characterization, and sensitivity and uncertainty methods: their necessary association for licensing. Eisenberg, N.A. (Department of Energy, Washington, DC (USA)); Rickertsen, L.D.; Voss, C. pp. 658 of Geostatistical, sensitivity, and uncertainty methods for ground-water flow and radionuclide transport modeling. Proceedings. Buxton, B.E. (ed.) Battelle Memorial Institute, Columbus, OH (1989). (CONF-870971--: Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference, San Francisco, CA, USA, 15-17 Sep 1987).

This paper briefly reviews the sources of uncertainty in performance assessment analyses and discusses the role that sensitivity and uncertainty methods play in the DOE's effort to develop and license a nuclear waste repository in a geologic medium. In keeping with the focus of this conference, these topics are related primarily to groundwater movement and radionuclide transport analyses. Because methods for quantifying uncertainty exist and are applied primarily for uncertainties arising from spatial variability, and to a lesser degree alternative conceptual models, much discussion in this paper regards these uncertainties. Other types of uncertainty may be equally or more important, but less information is available.

38192 Treatment of uncertainties in ground-water flow modeling in the Swiss radioactive waste program. Hufschmied, P. (National Cooperative for the Storage of Radioactive Waste, Baden (Switzerland)). pp. 658 of Geostatistical, sensitivity, and uncertainty methods for ground-water flow and radionuclide transport modeling. Proceedings. Buxton, B.E. (ed.) Battelle Memorial Institute, Columbus, OH (1989). (CONF-870971--: Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference, San Francisco, CA, USA, 15-17 Sep 1987).

The most plausible scenario for release of radionuclides from a geologic repository is by transport in moving ground-water. Accordingly, modeling of ground-water flow plays an important role in Swiss performance assessment work. Modeling takes place at different scales, beginning at a regional scale which gives boundary conditions for a smaller local-scale model. At the repository scale, a third model is being used to study the influence of major hydraulic

discontinuities near the repository. A fourth model finally describes the fine-scale flow in individual water-bearing features which are most important for radionuclide transport in the geosphere. Sensitivity of model parameters and approaches to treat uncertainties are different for the various scales. Main sources of uncertainty are (1) incomplete available data about the spatial distribution of hydrogeologic parameters and (2) measurement/interpretation errors. Significant effort has already been involved in understanding and quantifying uncertainty in results of hydraulic testing, and increasing attention is being focused upon the problem of the incompleteness of data. Efforts are under way to better quantify both types of uncertainties. Approaches to treat uncertainty in derived model parameters are discussed. Ultimately the methods proposed should allow one to link field data uncertainty and incomplete information to the uncertainty of hydrodynamic input parameters for radionuclide transport calculations. The methodology is being tested within the international project HYDROCOIN. The impact of hydrologic uncertainty considerations upon the ongoing and planned site characterization work as well as associated R&D needs of the Swiss program are discussed.

38193 Materials considerations in interim storage of spent fuel. Johnson, A.B. (Battelle - Pacific Northwest Lab., Richland, WA (US)); Gilbert, E.R.; Bailey, W.; Oden, D.R. v.v of Corrosion '85. National Assoc. of Corrosion Engineers, Houston, TX (1985). (CONF-850311–: National Association of Corrosion Engineers annual meeting and materials performance and corrosion show, Boston, MA, USA, 25-29 Mar 1985).

Fuel discharged from nuclear reactors must be stored until it is reprocessed or sent to repositories. Water storage is the only storage method currently licensed, but a basis is developing for dry storage licensing. Materials issues in wet and dry storage are summarized.

38194 Regulatory perspectives of concept assessment. Flavelle, P.A. (Atomic Energy Control Board, Ottawa, Ontario (Canada)). pp. 658 of Geostatistical, sensitivity, and uncertainty methods for ground-water flow and radionuclide transport modeling. Proceedings. Buxton, B.E. (ed.) Battelle Memorial Institute, Columbus, OH (1989). (CONF-870971–: Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference, San Francisco, CA, USA, 15-17 Sep 1987).

The Atomic Energy Control Board is the lead agency for the regulatory review of the Assessment of the Canadian Concept for Nuclear Fuel Waste Disposal being done by Atomic Energy of Canada Limited and Ontario Hydro. This paper describes the regulatory perspective of how the Concept Assessment could demonstrate the feasibility of a disposal system conforming to regulatory requirements. The long-term aspects of Concept Assessment encourage the use of various predictive techniques for different time scales. Each technique will have a different potential for establishing confidence in the predictions. The predicted performance of a facility during operation should have a very high confidence, as it can be based on standard engineering calculations and the predictions can be validated later by monitoring during operation. The predictions of the transient period following closure of the facility should achieve a medium level of confidence, since they can be based on extrapolations of predictions of operational performance, using models that can be calibrated with monitoring data and with averaged input data derived from natural analogue studies. Predictions based on fundamental processes will have a medium level of confidence when made to intermediate times after closure. Long-term predictions using generic or typical input data or Monte Carlo calculations of simplified models will have the least confidence, and yet they can still contribute to the confidence that the disposal concept will conform to regulatory requirements.

38195 Low-level radioactive waste site selection and site characterization handbooks. Tullis, J.A. (Idaho National Engineering Lab., EG and G Idaho Inc., Idaho Falls, ID (US)); Reyes, B.D.; Delaney, H.J.; Scott, J.D.; Stroh, P.T.; Dressen, A.L.; Anderson, R.G. v.v of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ, USA, 28 Feb - 3 mar 1988).

Two resource documents have been developed to provide technical assistance to states and compact regions in selecting and characterizing sites for disposal of low-level radioactive wastes (LLW). The Site Selection Handbook provides background information and materials for a workshop on the components of a comprehensive site selection program. The Site Characterization Handbook is a reference document for identifying and collecting the data required to support a license application for a LLW disposal facility.

38196 Mixed waste treatment at the Idaho National Engineering Laboratory. Larsen, M.M. (EG and G Idaho, Inc. (US)); Hunt, L.F.; Sanow, D.J. v.v of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ, USA, 28 Feb - 3 mar 1988).

The Idaho Operations Office of the Department of Energy (DOE) made the decision in 1984 to prohibit the disposal of mixed waste (MW) in the Idaho National Engineering Laboratory (INEL) low-level radioactive waste (LLW) disposal facility. As a result of this decision and due to there being no EPA-permitted MW treatment/storage/disposal (T/S/D) facilities, the development of waste treatment methods for MW was initiated and a storage facility was established to store these wastes while awaiting development of treatment systems. This report discusses the treatment systems developed and their status.

38197 Development of a general model to predict the rate of radionuclide release (source term) from a low-level waste shallow land burial facility. Sullivan, T.M. (Brookhaven National Lab., Upton, NY (US)); Kempf, C.R.; Suen, C.J.; Mughabghab, S.M. v.v of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ, USA, 28 Feb - 3 mar 1988).

Federal Code of Regulations 10 CFR 61 requires that any near surface disposal site be capable of being characterized, analyzed, and modeled. The objective of this program is to assist NRC in developing the ability to model a disposal site that conforms to these regulations. In particular, a general computer model capable of predicting the quantity and rate of radionuclide release from a shallow land burial trench, i.e., the source term, is being developed. The framework for this general model has been developed and consists of four basic compartments that represent the major processes that influence release. These compartments are: water flow, container degradation, release from the waste packages, and radionuclide transport. Models for water flow and radionuclide transport rely on the use of the computer codes FEMWATER and FEMWASTE. These codes are generally regarded as being state-of-the-art and required little modification for their application to this project. Models for container degradation and release from waste packages have been specifically developed for this project. This paper provides a brief description of the models being used in the source term project and examples of their use over a range of potential conditions.

38198 Mixed waste management operations at the Idaho Chemical Processing Plant. Pointer, T.F. (Idaho National Engineering Lab., Westinghouse Idaho Nuclear Co. (US)); Krivanek, K.R. v.v of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ, USA, 28 Feb - 3 mar 1988).

The U.S. Department of Energy's recent clarification of the Atomic Energy Act by-products rule in conjunction with the signing of the Environmental Protection Agency/Department of Energy Consent Order and Compliance Agreement for the Idaho National Engineering Laboratory now requires that mixed waste at the Idaho Chemical Processing Plant (ICPP) be regulated by both the AEA and the Resource Conservation and Recovery Act (RCRA). This paper describes how Westinghouse Idaho Nuclear Company (WINCO) ensures that its Mixed Waste Program at the ICPP complies with all applicable Federal and State hazardous waste laws and regulations.

38199 Strategic planning for waste management. Jolley, R.L. (Waste Management Technology Center, Oak Ridge National Lab., Oak Ridge, TN (US)); Rivera, A.L.; Fox, E.C.; Hyfantis, G.J.; McBrayer, J.F. v.v of Waste management '88. Post, R.G. University

of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ, USA, 28 Feb - 3 mar 1988).

Information about current and projected waste generation as well as available treatment, storage, and disposal (TSD) capabilities and needs is crucial for effective, efficient, and safe waste management. This is especially true for large corporations that are responsible for multisite operations involving diverse and complex industrial processes. Such information is necessary not only for day-to-day operations but also for strategic planning to ensure safe future performance. This paper reports on some methods developed and successfully applied to obtain requisite information and to assist waste management planning at the corporate level in a nationwide system of laboratories and industries. Waste generation and TSD capabilities at selected U.S. Department of Energy (DOE) sites were studied. Collecting, analyzing, and maintaining the quality assurance (QA) of quantitative data concerning waste generation and TSD can be complex and arduous. This is particularly so if the industry of industries are multifaceted and produce a large variety of wastes. For example, the national industrial complex operated under the auspices of the DOE involves approximately 30 sites as well as widely varied industrial operations, including metal fabrication and processing, machining, chemical processes involving hazardous and radioactive components, solvent recycle and recovery, and explosives testing.

38200 Analysis of the impact of the byproduct rule on the U.S. Department of Energy's Grand Junction Remedial Action programs. Falconer, K.L. (UNC Geotech, P.O. Box 14000, Grand Junction, CO (US)); Langdon, D.L.; Abramiuk, I.N.; Madson, M. v.v of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ, USA, 28 Feb - 3 mar 1988).

The byproduct rule resolved numerous issues with regard to the management of U.S. Department of Energy (DOE) radioactive waste which is also hazardous under the Resource Conservation and Recovery Act (RCRA). It did so by clarifying that radioactive waste that is hazardous under RCRA is subject to regulation under both RCRA and the Atomic Energy Act (AEA), with the exception of materials that are defined as byproduct under Section 11(e)(2) of the AEA, specifically uranium and thorium mill tailings. However, when remedial actions at sites involving uranium or thorium mill tailings are conducted, it is still necessary to examine each remedial project in its entirety in order to determine the applicability of EPA requirements. In this paper the background, regulatory status, and compliance approach of three DOE Remedial Action Projects involving mill tailings are examined.

38201 Applying the de minimis concept to mixed wastes. Davis, J.P. (General Physics Corp., San Diego, CA (US)); Chan, D.W.; Wofford, B.R. v.v of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ, USA, 28 Feb - 3 mar 1988).

In recent years, a concept of de minimis, below regulatory concern, threshold, or negligible levels of radiation dose and risk from low level waste has begun to be accepted by standard setting and regulatory bodies throughout the world, including ICRP, NCRP, IAEA, USNRC, USDOE, USEPA, and UKNRPB. Moreover, the de minimus principle has long been recognized by the courts and has been applied in the area of environmental health and industrial hygiene law. This paper reviews the precidence in these areas and addresses the reasonableness of establishing BRC levels for chemical, as well as radiological constituents of mixed wastes, in order to minimize the quantity of true mixed wastes that must be disposed of under a duel regulatory system. A two-tiered BRC approach is proposed, which would recognize that since waste deregulated for one of the constituents would still be strictly controlled, there could be conditional BRC levels established higher than those that would apply to cases where disposal of deregulated waste is essentially uncontrolled. This paper discusses some of the technical and transscientific concerns involved in implementing the BRC approach in the high profile world of environmental regulation.

38202 Regulation of radioactive mixed waste at the Waste Isolation Pilot Plant (WIPP) under the Resource Conservation and Recovery Act (RCRA). Hansen, R.P. (International Technology (IT) Corp., Englewood, CO (US) and Albuquerque, NM (US)); Hart, J.S. v.v of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ, USA, 28 Feb - 3 mar 1988).

This paper discusses Resource Conservation and Recovery Act (RCRA) (1) compliance issues pertinent to the placement of radioactive mixed waste in the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico. The discussion focuses on the mixed waste issue, the WIPP as an interim status facility, effects of RCRA land disposal prohibitions on the WIPP, regulation of geologic repositories as Subpart X miscellaneous units, and various inconsistencies between U.S. Department of Energy (DOE) requirements for the WIPP and the RCRA regulations. An approach to permitting the WIPP as a RCRA compliance facility is also addressed.

38203 Results of field testing of waste forms using lysimeters. McConnell, J.W. Jr. (Idaho National Engineering Lab., EG and G Idaho, Inc., Idaho Falls, ID (US)); Rogers, R.D. v.v of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ, USA, 28 Feb - 3 mar 1988).

The TMI-2 EPICOR-II Resin/Liner Low-Level Waste Data Base Development Program funded by the U.S. Nuclear Regulatory Commission (USNRC) is obtaining information on performance of radioactive waste in a disposal environment. Waste forms fabricated using ion exchange resins from EPICOR-II prefilters employed in the cleanup of the Three Mile Island Nuclear Power Station are being field tested to: (a) develop a low-level waste data base, and (b) obtain information on survivability of waste forms in a disposal environment. This paper updates field testing of those waste forms during FY 1987.

38204 Progress in developing new commercial LLRW disposal facilities and DOE assistance. Tait, T.D. (Idaho National Engineering Lab., EG and G Idaho, Inc., Idaho Falls, ID (US)); Hinschberger, S.T. v.v of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ, USA, 28 Feb - 3 mar 1988).

This paper reports state and regional progress in developing new commercial low-level radioactive waste disposal facilities. Specifically the paper addresses DOE determination of state and regional compliance with the 1988 milestone requirements of the Low-Level Radioactive Waste Policy Amendments Act of 1985 (LLRWPAA). In addition, the paper summarizes the assistance provided by the Department of Energy (DOE) to the states and regions in their efforts to develop new disposal facilities as mandated in the LLRWPAA.

38205 Evaluation of alternatives to shallow land burial at the Radioactive Waste Management Complex. Cerven, F. (Idaho National Engineering Lab., EG and G Idaho, Inc., Idaho Falls, ID (US)). v.v of Waste management '88. Post, R.G. University of Arizona Nuclear Engineering Dept., Tucson, AZ (1988). (CONF-880201–: Waste management '88: symposium on radioactive waste management, Tucson, AZ, USA, 28 Feb - 3 mar 1988).

Alternative waste disposal technologies were reviewed relative to Nuclear Regulatory Commission (NRC) 10 CFR 61 low level waste (LLW) disposal criteria and the emerging DOE 5820.2 Chapter III criteria. The intent of the review was to select a technology which would meet or improve upon the disposal practices set forth in these regulations and orders. The evaluation of the disposal technologies yielded a disposal design which incorporates three elements: an all earth cover, earth vaults for the Class A (I) bottom discharge cask inserts, and a concrete vault for the Class B and C (II and III) bulk waste.

38206 Process for cesium decontamination and immobilization. Komarneni, S.; Roy, R. To Dept. of Energy, Washington, DC. USA Patent 4,808,318. 28 Feb 1989. Filed date 25 Apr 1988. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

Cesium can be selectively recovered from a nuclear waste solution containing cesium together with other metal ions by contact with a modified phlogopite which is a hydrated, sodium phlogopite mica. Once the cesium has entered the modified phlogopite it is fixed and can be safely stored for long periods of time.

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Refer also to citation(s) 38108, 38137, 38138, 38139, 38140, 38141, 38142, 38143, 38146, 38147, 38148, 38149, 38150, 38154, 38155, 38161, 38162, 38163, 38164, 38167, 38168, 38169, 38170, 38171, 38172, 38173, 38174, 38176, 38177, 38179, 38180, 38181, 38182, 38183, 38184, 38185, 38186, 38187, 38188, 38189, 38195, 38201, 38203, 38211, 38212, 38213, 38214, 38215, 38216, 38217, 38218, 38219, 38220, 38221, 38222, 38223, 38224, 38252

38207 (INIS-mf–11448, pp. 19) **Metabolism of ^{226}Ra and Ca by freshwater mussels and turtles from Magela Creek.** Jeffree, R.A. (Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia)). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1987. (CONF-8708339–: 11. AINSE radiation biology conference, Lucas Heights, Australia, 24-25 Aug 1987). In *Conference handbook.* Order Number DE89616297/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

RADIUM 226/buildup; FOOD CHAINS; HUMAN POPULATIONS; INTAKE; MAN; METABOLISM; MOLLUSCS; RADIONUCLIDE KINETICS; BUILDUP; RIVERS; TURTLES; URANIUM MINES

38208 (ORNL/RASA–88/47) **Results of the radiological survey at 6 Branca Court, Lodi, New Jersey (LJ041).** Foley, R.D.; Floyd, L.M.; Carrier, R.F.; Crutcher, J.W. Oak Ridge National Lab., TN (USA). Jun 1989. 13p. Sponsored by DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89014961/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Maywood Chemical works (MCW) of Maywood, New Jersey, generated process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores from 1916 to 1956. MCW supplied rate earth metals and thorium compounds to the Atomic Energy Commission and various other government agencies from the late 1940s to the mid-1950s. Area residents used the sandlike waste from this thorium extraction process mixed with tea and cocoa leaves as mulch in their yards. Some of these contaminated wastes were also eroded from the site into Lodi Brook. At the request of the US Department of Energy (DOE), a group from Oak Ridge National Laboratory conducts investigative radiological surveys of properties in the vicinity of MCW to determine whether a property is contaminated with radioactive residues, principally ^{232}Th, derived from the MCW site. The survey typically includes direct measurement of gamma radiation levels and soil sampling for radionuclide analyses. The survey of this site, 6 Branca Court, Lodi, New Jersey (LJ041), was conducted during 1985 and 1986. Results of the survey demonstrated radionuclide concentrations in excess of the DOE Formerly Utilized Sites Remedial Act program criteria. The radionuclide distributions are typical of the type of material originating from the MCW site. 6 figs., 3 tabs.

38209 (ORNL/RASA–88/70) **Results of the radiological survey at 112 Avenue E, Lodi, New Jersey (LJ082).** Foley, R.D.; Floyd, L.M. Oak Ridge National Lab., TN (USA). Jun 1989. 9p. Sponsored by DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89014962/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Maywood Chemical Works (MCW) of Maywood, New Jersey, generated process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores from 1916 to 1956. MCW supplied rare earth metals and thorium compounds to the Atomic Energy Commission and various other government agencies from the late 1940s to the mid-1950s. Area residents used the sandlike waste from this thorium extraction process mixed with tea and cocoa leaves as mulch in their yards. Some of these contaminated wastes were also eroded from the site into Lodi Brook. At the request of the US Department of Energy (DOE), a group from Oak Ridge National Laboratory conducts investigative radiological surveys of properties in the vicinity of MCW to determine whether a property is contaminated with radioactive residue, principally ^{232}Th, derived from the MCW site. The survey typically includes direct measurement of gamma radiation levels and soil sampling for radionuclide analyses. The survey of this site, 112 Avenue E, Lodi, New Jersey (LJ082), was conducted during 1988. Results of the survey demonstrated radionuclide concentrations in excess of the DOE Formerly Utilized Sites Remedial Action Program criteria. The radionuclide distributions are typical of the type of material originating from the MCW site. 2 figs., 3 tabs.

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Refer also to citation(s) 38183, 38184, 38201, 38239, 38244, 38252, 39039, 39323, 39324, 39326, 39327, 39328, 39550, 39551, 39552, 39553, 39555, 39556, 39557, 39558, 39559, 39561, 39562, 39563, 39564, 39569, 39571, 39586, 39587

38210 (BNWL-CC–2011) **Some observations on airborne releases accompanying serious incidents involving plutonium.** Mishima, J. Battelle Pacific Northwest Lab., Richland, WA (USA). 7 Feb 1969. 63p. Sponsored by DOE Environment Health & Safety. DOE Contract AC06-76RL01830. Order Number DE89014160/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Accidents and potential accidents involving plutonium in processing facilities and accidents are briefly reviewed. Data available regarding plutonium aerosol released are used to access the release of plutonium aerosols in potentially serious accidents, and conclusions drawn regarding adequacy of the existing data. Of the loss-of-control incidents involving plutonium and its compounds which have occurred, 74% resulted in airborne contamination. Overpressurization and explosion accounted for most of airborne contamination. Liquids and powders were the physical forms most frequently involved. Five incidents have been postulated which have the greatest potential hazard in ARHCO plutonium processing, handling, and storage facilities. Fractional release factors generated in the research to date proved useful in assessing the release in several potential accidents, yet more realistically scaled experiments are needed. This is particularly true for a waste hutment fire. A brief scope of larger scale experiments is discussed. Materials which can be used as a stand-in for the toxic plutonium were investigated with a decision that uranium would be an adequate stand-in for the research yet to be performed. 39 refs., 2 figs., 1 tab.

38211 (CONF-8810239–Absts., pp. 3.1) **Status report groundwater: the challenge for UMTRA completion.** D'Antonio, J.R. (Uranium Mill Tailings Remedial Action Project, Albuquerque, NM (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; Gaithersburg, MD, USA; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

UMTRA is working aggressively towards meeting the intent of the draft EPA Groundwater Protection Standards. Since September 1987, the major UMTRA thrust has been threefold: (1) perform special studies directed towards design enhancements; (2) provide design enhancements, where possible for projects under construction; and (3) evaluate the remaining sites under design for design enhancements under the proposed standards. At the time, the NRC has taken a very guarded approach towards approving proposed cover systems. UMTRA believes current cell designs will meet proposed standards. UMTRA is working closely with the NRC towards understanding the resolution of issues related to the acceptability of designs to meet the EPA groundwater standards. UMTRA met with NRC the week of October 17, 1988 to discuss results of recent special studies. Recent studies include: field moisture content validations of completed covers, soil/rock covers, rock durability, soil amendments, freeze-thaw, and erosion protection and constructability questions. When completed, UMTRA will issue final special study reports. Two of the above areas, freeze-thaw and rock durability, will be presented in the presentations which follow this one. Another of the special studies addressing design approaches to cell designs is presented in Session V.

38212 (CONF-8810239–Absts., pp. 5.13) **Effects of the proposed EPA groundwater standards on the Uranium Mill Tailings Remedial Action Project.** Titus, F.B. (Jacobs Engineering Group, Inc., Albuquerque, NM (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; Gaithersburg, MD, USA; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

Potential groundwater contamination beneath the 24 tailings piles that are to be stabilized under the UMTRA Project was intended in early project plans to be minimized by placing disposal piles over thick stratigraphic sequences of tight (minimally permeable) formations, and by designing covers that contained low permeability soil/clay infiltration barriers. The court-ordered revision of the UMTRA groundwater standards by EPA (proposed standards of September 1987) include very low Maximum Concentration Limits (MCLs), which are based mostly on Primary Drinking Water Standards. EPA also mandates that the designs should control radioactivity and hazardous constituents...for up to one thousand years, to the extends reasonably achievable, and, in any case, for at least two hundred years.... In order to accommodate this stipulation, transport modeling of water and contaminants in both the vadose and saturated zones beneath the piles is run until steady state conditions are reached. The early decision to locate stabilized piles over tight formations now exacerbates the problem of complying with the standards, since the contaminants percolate to groundwater that moves only slowly through strata having low permeabilities. Innovative solutions have been evaluated that are aimed at further minimizing long-term infiltration, geochemically fixing contaminants in place before they reach groundwater, or otherwise minimizing contaminant flux.

38213 (CONF-8810239–Absts., pp. 1.21-1.24) **Defense Environmental Restoration Program.** Carricato, M.J. (Dept. of Defense, Washington, DC (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; Gaithersburg, MD, USA; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

The Defense Environmental Restoration Program (DERP), established by the Congress in 1984, provides increased emphasis and visibility for an expanded and accelerated effort for cleanup actions at toxic and hazardous waste sites on DOD installations and provides for cleanup of properties formerly used by the DOD. There are about 3,800 sites on active installations with the potential for contamination. The Installation Restoration program, an integral part of the Environmental Restoration program, identifies contamination and provides appropriate studies and remedial actions at these potential sites. Additionally, there are approximately 7,200 identified potential hazardous toxic waste sites on properties formerly owned or used by the DOD which require investigation as to the degree of DOD responsibility, if any. This includes possible requirements for the removal of unsafe and hazardous buildings, structures and debris. The Building Demolition/Debris Removal sub-element of the Environmental Restoration Program addressed the cleanup of these sites. Other Hazardous Waste Operations is also included under the restoration program. This involves initiatives related to the reduction of DOD hazardous waste generated and disposed; research, development and demonstration with respect to hazardous wastes and site cleanups, including safer, more cost-effective methods of unexploded ordinance detection and disposal; and clearance of active and former ranges. This activity represents a small percentage of the total restoration effort.

38214 (CONF-8810239–Absts., pp. 2.1-2.13) **DOE groundwater protection strategy.** Lichtman, S. (Dept. of Energy, Washington, DC (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; Gaithersburg, MD, USA; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

EH is developing a DOE-wide Groundwater Quality Protection Strategy to express DOE's commitment to the protection of groundwater quality at or near its facilities. This strategy responds to a September 1986 recommendation of the General Accounting Office. It builds on EPA's August 1984 Ground-Water Protection Strategy, which establishes a classification system designed to protect groundwater according to its value and vulnerability. The purposes of DOE's strategy are to highlight groundwater protection as part of current DOE programs and future Departmental planning, to guide DOE managers in developing site-specific groundwater protection practices where DOE has discretion, and to guide DOE's approach to negotiations with EPA/states where regulatory processes apply to groundwater protection at Departmental facilities. The strategy calls for the prevention of groundwater contamination and the cleanup of groundwater commensurate with its usefulness. It would require long-term groundwater protection with reliance on physical rather than institutional control methods. The strategy provides guidance on providing long-term protection of groundwater resources; standards for new remedial actions;guidance on establishing points of compliance; requirements for establishing classification review area; and general guidance on obtaining variances, where applicable, from regulatory requirements. It also outlines management tools to implement this strategy.

38215 (CONF-8810239–Absts., pp. 2.15-2.28) **Remedial actions and the need to communicate about risks.** Fisher, A. (Environmental Protection Agency, Washington, DC (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; Gaithersburg, MD, USA; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

Communicating effectively about risks can help people put risks in context, understand the trade-offs that must be made between reducing risks and the costs of doing so, become informed participants in decision about risk management, and understand the residual risks that remain after action has been taken. Each of these objectives can be important in communication about remedial action. Concern can be explained by a model of risk judgment. The empirical work to test this model is preliminary, but the first step of the model is to decide whether the risk is worth considering. If the answer is No, then the individual tends to dismiss the risk and show no concern – less concern than seems merited by the scientific risk estimates. If the answer is Yes, the risk judgment model suggests a more complex process. People apparently anchor on the magnitude of consequences that could occur. However, the adjustment tends to be incomplete, and even a small overestimate of the probability of harm means that the level of concern will be much higher than seems merited by the scientific risk estimates. Two policy questions arise from this model: (1) Which mode (dismissal or concern) is most appropriate in a given situation? (2) What policy actions can move people to the more appropriate mode? Several risk communication recommendations follow for remedial action. Some of them duplicate the Seven Cardinal Rules of Risk Communication. In both cases, following the suggestions does not guarantee effective risk communication. This is still an emerging field, and the research has not yielded a fail-safe method. However, not following all the suggestions is likely to result in a failed risk communication effort.

38216 (CONF-8810239–Absts., pp. 3.19-3.20) **Status report long-term surveillance and maintenance.** Matthews, M. (Dept. of Energy, Washington, DC (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; Gaithersburg, MD, USA; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

Surveillance and maintenance (S&M) are those activities, such as monitoring, maintenance, and emergency measures, which are undertaken at a site after remedial actions are complete in order to protect the public health, safety and the environment. These activities may be pursuant to a license from the Nuclear Regulatory Commission, or other agency, as appropriate. The purpose of the working group is to: (1) Review post-closure S&M requirements,

standards, practices and costs; (2) Identify and explore area of commonality and differences; and (3) Make recommendations for projects' policies and actions.

38217 (CONF-8810239–Absts., pp. 3.103-3.137) **Guidelines supplement and RESRAD code.** Yuan, Y.C. (Argonne National Lab., IL (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; Gaithersburg, MD, USA; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

A manual, which provides information for implementing DOE's residual radioactive material guidelines, and a computer code (RESRAD), which implements this manual, have been developed for the US Department of Energy to derive guidelines for residual radioactive materials at sites identified by the Formerly Utilized Remedial Action Program (FUSRAP) and remote sites identified by the Surplus Facilities Management Program (SFMP). A guideline is defined as a radionuclide concentration or a radiation or radioactivity level that is acceptable if a site is to be certified for unrestricted release. The derived radionuclide concentration guidelines in soil are based on the requirement that the 50-year committed effective dose equivalent to a hypothetical individual who lives or works in the immediate vicinity of an identified site should not exceed a dose of 100 mrem/yr following decontamination. In the RESRAD code, potential radiation doses resulting from seven exposure pathways are analyzed. The RESRAD computer code has been applied to several FUSRAP sites at which decontamination activities are currently being carried out. The RESRAD code is easy to use and very user-friendly; it was developed to run on an IBM-compatible personal computer with a hard disk drive.

38218 (CONF-8810239–Absts., pp. 3.21-3.34) **Canonsburg Surveillance and Maintenance: a case history.** Glover, W. (Roy F. Weston, Inc., Albuquerque, NM (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; Gaithersburg, MD, USA; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

The purpose of this presentation is to provide a history of the Surveillance and Maintenance (S&M) program at the Canonsburg, Pennsylvania Uranium Mill Tailings Remedial Action (UMTRA) site and to relate the Canonsburg experiences to the overall UMTRA S&M program. The Canonsburg site was the first inactive uranium mill tailings site to be remediated pursuant to the provisions of Title I of the Uranium Mill Tailings Radiation Control Act (UMTRA). The S&M program for Canonsburg was initiated in 1986 with the submittal to the Nuclear Regulatory Commission of the Final Canonsburg S&M plan. The primary purpose of the UMTRA project's S&M program is to verify that the remediated tailings disposal facilities are continuing to function as designed.

38219 (CONF-8810239–Absts., pp. 3.83-3.101) **Surface contamination guidelines.** Berger, J.D. (Oak Ridge Associated Universities, TN (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; Gaithersburg, MD, USA; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

The DOE surface contamination guidelines, used by FUSRAP and SFMP, were adopted from those which have been followed by the AEC/NRC for termination of licenses, since the early 1970's. Although later versions have been developed, the July 1982 version is the basis for the DOE guidelines. These guidelines are divided into four general groupings of radionuclides; groupings were developed based on the permissible air concentrations in unrestricted areas in effect during the early 1970's. There are other sources of surface contamination guidelines, for example, NRC Regulatory Guide 1.86 and draft ANSI N13.12. Most states use the NRC guidelines, but several states have chosen to develop their surface contamination limits. FUSRAP and SFMP have used these guidelines for about four or five years. Only minor problems were encountered until recently, when a site with multiple radionuclides, painted surfaces, and dusty surfaces created some problems in measuring contamination levels and interpreting the results. It is recommended that a comprehensive protocol for application of the surface contamination guidelines be prepared. All monitoring personnel must continue to strive to improve procedures and equipment for optimal sensitivity and accuracy. Finally, some changes in the guidelines might be appropriate.

38220 (CONF-8810239–Absts., pp. 4.19-4.35) **D&D crew size: bigger isn't always better.** Boing, L. (Argonne National Lab., IL (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; Gaithersburg, MD, USA; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

The D&D crew size necessary or best suited to a particular project is dependent on six factors. These six factors are: (1) available funding, (2) D&D experience, (3) union constraints, (4) size of work area, (5) radiation levels, and (6) staffing level of D&D organization. Concerns within these six factors are as follows: Available funding; D&D experience; Union constraints; Size of work area: large, small, multiple buildings, single buildings, confined, indoor or outdoor area. Radiation levels; and Staffing level of D&D organization.

38221 (CONF-8810239–Absts., pp. 5.1-5.12) **Optimizing the efficiency of the drilling program at the Ashland 2 site.** McNamee, E.M. (Bechtel National, Inc., Oak Ridge, TN (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; Gaithersburg, MD, USA; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

Balancing the cost of thorough site characterization against uncertainties encountered during remedial action has always been a major consideration in performing remedial action under the US Department of Energy's Formerly Utilized Sites Remedial Action Program (FUSRAP). The ideal solution is to keep characterization costs at the minimum level necessary to obtain the amount of information needed to remediate all the contamination without treating excess amounts of uncontaminated materials. This delicate balance is especially to maintain in characterizing heterogeneous deposits of subsurface contamination. On many FUSRAP sites, little is known about the specific location of the contamination. A systematic sampling approach is generally implemented at these sites, because this approach supplies statistically significant data for the entire site. One of the drawbacks of the systematic sampling method is that large portions of the site that are not contaminated are also characterized, resulting in unnecessary increases in characterization costs. During the initial planning for characterization of the Ashland 2 site (located near Tonawanda, New York), a systematic sampling methodology was initially selected. If this method had been implemented, 108 sampling locations would have been established across the Ashland 2 site. However, as planning progressed, a new sampling methodology was developed and implemented. This methodology uses an iterative approach and consists of the placement of biased sampling locations to determine the horizontal boundaries of contamination.

38222 (CONF-8810239–Absts., pp. 5.15-5.41) **Impact of proposed EPA groundwater standards on UMTRA project disposal cell design.** Caldwell, J.A. (Jacobs Engineering Group, Inc., Albuquerque, NM (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; Gaithersburg, MD, USA; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

In 1987, EPA published draft ground water standards applicable to all Uranium Mill Tailing Remedial Action (UMTRA) Project sites. Publication of these standards created a need to evaluate both the performance of previous UMTRA Project disposal cell designs and the extent to which these designs facilitated or led to compliance with the proposed groundwater standards. Such an evaluation

yielded guidance for the compilation, on a site-specific basis, or disposal cell designs that will lead to compliance with the proposed EPA groundwater standards.

38223 (CONF-8810239–Absts., pp. 5.59-5.74) **Presentation on the role or risk assessment in FUSRAP remedial planning.** Adler, D. (Bechtel National, Inc., Oak Ridge, TN (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; Gaithersburg, MD, USA; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

Although the primary emphasis of the FUSRAP program is to mitigate hazards by removing and disposing of contamination exceeding relevant generic guidelines, current FUSRAP protocol allows for application of supplemental risk-based standards in unique cases where generic standards are inappropriate. This presentation provides background information on the rationale supporting current generic cleanup standards, and how site-specific, risk-based standards can be applied to improve the cost effectiveness of overall remedial strategies. The current DOE process for development, review and granting of supplemental standards is discussed. The discussion includes a description of experience being gained through development of supplemental standards for the Albany Research Center (ARC) FUSRAP site. In particular, the presentation focuses on the methodology used to assess potential exposure risks posed by residual contamination at the ARC, cost and cost-benefit information compiled to support application of supplemental standards at ARC, and general issues identified during the development of supplemental standards. Criteria used to evaluate the appropriateness of applying supplemental standards to a specific situation are discussed. Finally, several examples of residual contamination at FUSRAP sites which may be considered for supplemental standards are identified and discussed.

38224 (CONF-8810239–Absts., pp. 5.75-5.110) **Low-level, transuranic, and mixed waste disposal at DOE sites.** Shupe, M.W. (DOE-Idaho Operations Office, Idaho Falls (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; Gaithersburg, MD, USA; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

This presentation discussed DOE-generated waste, waste disposal facilities, and waste disposal policies and practices for low-level waste (LLW), transuranic waste (TRU), and mixed waste (MW), emphasizing the impact the policies may have on decontamination and decommissioning (D&D) operations. The requirements for LLW, TRU, and MW established by the new DOE Order 5820.2A are presented. These address waste form, waste certification, waste packaging, waste characterization, and operational policies. Each waste type is then discussed in greater detail. For LLW, the DOE disposal sites and their current estimated disposal capacities are shown. The current generation rate for Defense Program Operations is approximately 100,000 cubic meters per year. Information obtained from the Integrated Data Base (IDB) indicates that the LLW estimated to be generated during the next 15 years by the Surplus Facilities Management Program will exceed current DOE disposal capacity. It is likely, however, that the projections are incorrect, rather than that storage capacity is a problem. The apparent intent of SFMP sites is to dispose of the maximum allowable quantities on site.

38225 (INIS-mf–11457(v.1,2) v. 2) **Evaluation of a microcomputer system for controlling and monitoring radiation hazards in uranium mines.** Sheeran, C.T. (Department of the Interior, Washington, DC (USA)); Franklin, J.C. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

A microcomputer-based monitoring and alarm system was tested in two active U.S. uranium mines. The system monitored radon, radon daughters, air velocity, air door position, and fan operation. The computer was programmed to control fans at predetermined times, after power failures, and when radiation levels exceeded preset values. Major problems that occurred during the two tests were power fluctuation and broken cables. The power problem was corrected by installing an uninterruptible power supply. Cut and damaged cables could be reduced by better placement and guarding.

38226 (INIS-mf–11457(v.1,2) v. 2) **Electrical properties of radon daughters.** Jonassen, N. (Technical Univ. of Denmark, Lingby (Denmark). Lab. of Applied Physics I). Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The short-lived airborne radon daughters may exist as ions having mobilities in the same range as ordinary atmospheric ions. The paper reports some results of an investigation of the effects of electric fields on airborne radon daughters. The collection efficiency for radon daughters of metal discs kept at various potentials above ground are determined in atmospheres with different fractions of the radon daughters being in the unattached state. The measurements indicate that in certain atmospheres the fractions of attached radon daughters which may be affected by an electric field is as high as 50 percent while in the same atmospheres maybe only 10-20 percent of the unattached daughters are affected. Preliminary measurements seem to indicate that in the same type of atmospheres most of the charged radon daughters have mobilites in the range 10^{-7} - 10^{-9} $m^2V^{-1}s^{-1}$.

38227 (INIS-mf–11457(v.1,2) v. 2) **Thoron daughter to radon daughter ratios in mines.** Stranden, E. (National Inst. of Radiation Hygiene, Osteras (Norway)). Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The thoron daughter to radon daughter ratios in mines are discussed. Measurements of the ratio in Norwegian mines are presented, and these results are compared to results obtained in Canadian uranium mines. Where the concentration of Th-232 in rock is high, the thoron daughters may dominate the doses to the miners.

38228 (INIS-mf–11457(v.1,2) v. 2) **Plenary address: ventilation.** Martinson, M.J. (University of the Witwatersrand, Johannesburg (South Africa)). Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Alpha radiation and other atmospheric hazards are primarily abated by circulating adequate quantities of fresh air through mine workings. Assuming that the risk of occupational injuries attributable to atmospheric hazards is in many instances still too high, the paper reviews the general state of the art of mine ventilation, attempts to identify significant shortcomings, and suggests changes aimed at reducing the risk of injury associated with atmospheric hazards in mines.

38229 **DOE procurement activities for spent fuel shipping casks.** Callaghan, E.F. (Office of Civilian Radioactive Waste Management, United States Dept. of Energy, Washington, DC (US)); Lake, W.H. v.v of Proceedings of the Institute of Nuclear Materials Management spent fuel management seminar V. C.E. Pietri, Northbrook, IL (1988). (CONF-880125–: Institute of Nuclear Materials Management: spent fuel management seminar, Washington, DC, USA, 20-22 Jan 1988).

The DOE cask development program satisfies the requirements of the NWPA by providing safe efficient casks on a timely schedule. The casks are certified by the NRC in compliance with the 1987 amendment to NWPA. Private industry is used to the maximum extent. DOE encourages use of present cask technology, but does not hesitate to advance the state-of-the-art to improve efficiency in transport operations, provided that safety is not compromised. DOE supports the contractor's efforts to advance the state-of-the-art by maintaining a technical development effort that responds to the common needs of all the contractors. DOE and the cask contractors develop comprehensive and well integrated programs of test and analysis for cask certification. Finally, the DOE monitors the cask development program within a system that fosters early identification of improvement opportunities as well as potential problems, and is sufficiently flexible to respond quickly yet rationally to assure a fully successful program.

38230 Utility perspectives on the transportation interface. Trasten, L.M. (LeBoeuf, Lamb, Leiby and MacRae, Washington, DC (US)); Buren, M.A. v.v of Proceedings of the Institute of Nuclear Materials Management spent fuel management seminar V. C.E. Pietri, Northbrook, IL (1988). (CONF-880125–: Institute of Nuclear Materials Management: spent fuel management seminar, Washington, DC, USA, 20-22 Jan 1988).

Utilities, cask vendors, carriers, DOE and others involved in the transportation industry must continue to work together to identify and resolve interface issues with the goal of ensuring that an optimum transportation program is in place and operational when DOE is ready to begin shipping spent fuel. The Nuclear Transportation Group intends to continue to take an active role in this effort in 1988 and continue to take an active role in this effort in 1988 and thereafter to ensure that DOE is aware of and addresses utilities' concerns.

38231 Results of studies on the behavior of spent fuel in storage. Gilbert, E.R. (Pacific Northwest Lab., Richland, WA (US)); Bailey, W.J.; Johnson, A.B. Jr. v.v of Proceedings of the Institute of Nuclear Materials Management spent fuel management seminar V. C.E. Pietri, Northbrook, IL (1988). (CONF-880125–: Institute of Nuclear Materials Management: spent fuel management seminar, Washington, DC, USA, 20-22 Jan 1988).

Spent fuel integrity is a major consideration in licensing actions for spent fuel storage technologies. While wet storage continues to be the predominant U.S spent fuel management technology, dry storage has been licensed and implemented in the U.S. Rod consolidation technology is being developed and demonstrated. This paper summarizes the status of technology trends and understanding regarding fuel behavior for the three technologies.

38232 Accountancy considerations for spent fuel management. Higinbotham, W.A. (Brookhaven National Lab. (US)). v.v of Proceedings of the Institute of Nuclear Materials Management spent fuel management seminar V. C.E. Pietri, Northbrook, IL (1988). (CONF-880125–: Institute of Nuclear Materials Management: spent fuel management seminar, Washington, DC, USA, 20-22 Jan 1988).

Early in the Carter administration, the United States decided to forego reprocessing and attempted to persuade the rest of the world to follow our example. The decision to adopt the once-through fuel cycle led to the present spent fuel policy which promises that the Federal Government takes responsibility for storage and disposal of the spent fuel from U.S. reactors toward the end of the century and for a price. In the meantime, nuclear power reactor operators must find some way to store their spent fuel by cramming more fuel into the storage pools and using dry storage near the reactors. How to accomplish these tasks safely and economically is the subject of these seminars.

0550 Safeguards, Inspection, and Accountability

Refer also to citation(s) 38200, 38201, 38202, 39083

38233 (BNL–52201) **Selected text of Atomic Energy Act, executive orders and other laws of general interest to safeguards and security officers.** Cadwell, J.J. Brookhaven National Lab., Upton, NY (USA). Sep 1988. 277p. Sponsored by DOE Defense Programs. DOE Contract AC02-76CH00016. Order Number DE89014412/JAW. Available from NTIS, PC A13/MF A01 - OSTI.

This text provides a listing of Atomic Energy Act, executive orders and other laws. Areas covered include: Atomic Energy Act of 1954 as amended – provisions of general interest, production of special nuclear material, special nuclear material, source material, byproduct material, military application of atomic energy, atomic energy licenses, international activities, control of information, general authority, judicial review and administrative procedure, and enforcement.

38234 (BNL–52202) **US statutes of general interest to safeguards and security officers.** Cadwell, J.J. Brookhaven National Lab., Upton, NY (USA). Sep 1988. 58p. Sponsored by DOE Defense Programs. DOE Contract AC02-76CH00016. Order Number DE89014411/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This manual is meant to serve as reference material for security personnel. Information on law violations and possible punishments are listed in the following format: offense, description, punishment, and cross reference. (JEF)

38235 (DP-MS–89-22) **Blue collar NDA [nondestructive assay] systems.** Studley, R.V. Westinghouse Savannah River Co., Aiken, SC (USA). 1989. 6p. Sponsored by DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-890736–33: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, FL, USA, 9-12 Jul 1989). Order Number DE89014143/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

One of the facilities at the Savannah River Plant includes eight high-technology microcomputer based nondestructive assay systems. These assay instruments were developed and fabricated for this facility by the N-1 group at Los Alamos National Laboratories. Thirty two additional NDA systems of three types are also used in this facility. These instruments provide valuable service for accountability and material control and in addition for nuclear criticality safety and process control. While this equipment is assembled from more mundane commercially available or simple, locally constructed mechanical assemblies plus commercially available instrumentation, some mechanical and instrument arrangements are unique and similar systems have not been seen in many SNM handling facilities. A special procedure providing traceability of calibrations to national measurement standards is used for most of this equipment. This paper will concentrate on the mechanical and instrument arrangements of these blue collar systems, their calibration and how they have been useful in this process. 3 refs., 5 figs.

38236 (DP-MS–89-37) **Overview of a measurements/measurement control symposium.** Clark, J.P. Westinghouse Savannah River Co., Aiken, SC (USA). 1989. 7p. Sponsored by DOE Defense Programs. DOE Contract AC09-76SR00001. (CONF-890736–40: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, FL, USA, 9-12 Jul 1989). Order Number DE89014149/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A symposium on measurements and measurement control (M/MC) for materials control & accountability (MC&A) was held October 25–27, 1989 at the Savannah River Site (SRS) in conjunction with an INMM Subcommittee 5.1 meeting. Its members, representatives from the Department of Energy (DOE) & Nuclear Regulatory Commission (NRC) and SRS personnel explored M/MC in relation to requirements specified in DOE Order 5633.3 "Control and accountability of Nuclear Materials" (2-3-88) and discussed how the implementation of applicable national standards could satisfy most of the requirements for M/MC. The symposium was divided into three sessions: M/MC Requirements and Applicable National Standards; Overviews of M/MC Activities at NRC and DOE Sites; and Workshops covering M/MC requirements. Workshop topics included: Analytical Laboratories; Statistical Methods; Process Controls; Nondestructive Analyses; Chemical Analyses; Sampling and Process Measurements; Training and Qualification of Measurement Personnel; Measurement Methods; and Organization & Quality Verification. An overview of the symposium including background, its purpose, the participants, the requirements, applicable national standards, summaries of the workshops and comments of the participants are discussed in the paper.

38237 (DP-MS–89-43) **Performance testing.** Wilson, W.A. Westinghouse Savannah River Co., Aiken, SC (USA). 1989. 3p. Sponsored by DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-890736–35: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, FL, USA, 9-12 Jul 1989). Order Number DE89014141/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Because of the increased emphasis on prevention of theft or diversion of Special Nuclear Material (SNM) by an "insider", a program of insider exercises has been implemented at the Savannah River Site (SRS). These limited scope exercises test the effectiveness of the various material control safeguard features such as the two-man rule, Material Access Area (MAA) boundary controls, storage vault entry/exit controls, etc. The exercise are coordinated by the central Material Control and Accountability (MC and A) organization and involve facility operations personnel and the site security contractor. Exercises are carefully controlled by extensive use of controllers at strategic locations in the facility.

38238 (DP-MS–89-44) **Auditing and inspection-area liason program.** Wilson, W.A. Westinghouse Savannah River Co., Aiken, SC (USA). 1989. 3p. Sponsored by DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-890736–32: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, FL, USA, 9-12 Jul 1989). Order Number DE89014145/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Prior to 1986 the Material Control and Accountability (MC and A) organization at the Savannah River Site (SRS) was centrally located in the administration area. Since most production facilities are located at least 7-15 miles from the administration area, there was very little interaction between MC and A and operations personnel. Oversight of site material control and accountability practices was limited to periodic audits conducted by an accountant assigned to the MC and A organization. These audits focused mainly on accountability practices. With increased emphasis placed on material control in recent years, it became imperative that the MC and A organization have representation in the production areas at SRS. Therefore, the position of MC and A area liaison was formed. The concept was to place technical personnel in the key production areas at SRS to assume MC and A auditing responsibilities in those areas, and more importantly, interact with area personnel to provide MC and A oversight and guidance on a day-to-day basis

38239 (K/ITP–250) **Nondestructive assay measurements of gaseous diffusion process equipment.** Cooley, J.N.; Fields, L.W.; Hagenauer, R.C.; Herron, S.A.; Mayer, R.L.; Whitaker, J.M. Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA). 28 Jun 1989. 5p. Sponsored by DOE Nuclear Energy. DOE Contract AC05-84OT21400. (CONF-890736–43: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, FL, USA, 9-12 Jul 1989). Order Number DE89015498/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A nondestructive assay (NDA) measurement survey program has been established at Oak Ridge Gaseous Diffusion Plant in Oak Ridge, Tennessee, to support decontamination and decommissioning (D and D) activities at the shutdown facility. The program's objective is to develop and to implement NDA measurement techniques for estimating the residual uranium contained in the diffusion process equipment and ancillary piping of the shutdown process buildings onsite. Measurement techniques are described, support programs (e.g., technician training, hardware development, and quality assurance) are detailed and results are summarized. The organizations, development, and implementation of a large-scale NDA measurement survey program to provide reliable process holdup data for D and D activities is being successfully demonstrated. 2 figs.

38240 (K/ITP–252) **An overview of measurement methods for special nuclear material in spent nuclear fuel.** Moran, B.W.; Reich, W.J. Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA). Jul 1989. 6p. Sponsored by DOE Nuclear Energy. DOE Contract AC05-84OT21400. (CONF-890736–41: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, FL, USA, 9-12 Jul 1989). Order Number DE89015496/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Summary results from a survey of nondestructive assay measurement methods applicable to the measurement of the special nuclear material content of spent nuclear fuel are described. The role of nuclear materials measurements in the domestic and international safeguarding of spent nuclear fuel in the United States' federal waste management system has yet to be determined. An understanding of the characteristics and capabilities of the potentially applicable measurement systems should provide valuable information to the developers of the safeguards approaches for the monitored retrievable storage and final disposal systems. The discussion focuses on the general characteristics of the identified direct and indirect measurement methods. 3 refs., 1 tab.

38241 (K/ITP–253) **A statistical plan for meeting the US Department of Energy's material control and accountability performance requirements.** Moran, B.W.; Johnson, P.S.; Zolyniak, J.W. Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA). Jul 1989. 4p. Sponsored by DOE Nuclear Energy. DOE Contract AC05-84OT21400. (CONF-890736–42: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, FL, USA, 9-12 Jul 1989). Order Number DE89015497/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

An inventory verification procedure was developed for facilities with very large and diverse item inventories to meet the material control and accountability performance requirements specified in the US Department of Energy orders for protracted thefts or diversions. The large number of special nuclear material (SNM)-bearing items in the material balance area inventory mandates that a statistical sampling plan be implemented. Containment of the SNM in a wide range of quantities and in different types of items permits the stratification of the inventory into ranges defined by the attractiveness of the SNM. The attractiveness of the SNM is defined by the average quantity of ^{235}U removable by an adversary per man-hour. Inventory verification periods were determined from the minimum length of time required for an adversary to obtain the target quantity of SNM from each stratum. The number of items to be verified within each stratum was calculated based on the desired detection probability. 3 refs., 3 tabs.

38242 (LA–11609-MS) **International safeguards for a MOX facility–verification to detect protracted falsification.** Picard, R.R.; Pillay, K.K.S. Los Alamos National Lab., NM (USA). Jul 1989. 36p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-36. Order Number DE89014403/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The theoretical underpinnings of sequential material unaccounted for minus the difference statistic [(MUF-D)] analysis are developed. Methodologically, procedures applicable to sequential MUF data can, in many cases, be adapted to the (MUF-D) problem. Detection of protracted falsification is illustrated in a system study of a modern, state-of-the-art mixed oxide fuel fabrication facility. 12 refs., 2 figs., 7 tabs.

38243 (LA–11632-MS) **Detecting change with digital imaging: An application in nuclear safeguards.** Steverson, C.A. Los Alamos National Lab., NM (USA). Aug 1989. 17p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-36. Order Number DE89014413/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Recent advances in computer and imaging technology have provided a cost effective means for the application of image processing methods in a variety of disciplines. For security and safeguards applications, image subtraction and other methods of change detection have shown security problems. This report describes research done by the Safeguards Systems Group at Los Alamos National Laboratory involving the use of image subtraction and image processing techniques for security applications. 1 ref., 12 figs.

38244 (NUREG–1272-Vol.3-No.2) **Office for Analysis and Evaluation of Operational Data: 1988 annual report, Nonreactors.** Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data. Jun 1989. 62p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A04/MF A01 - GPO - OSTI.

The annual report of the US Nuclear Regulatory Commission's Office for Analysis and evaluation of Operational Data (AEOD) is

devoted to the activities performed during 1988. The report is published in two separate parts. NUREG-1272, Vol.3, No.1, covers Power Reactors and presents an overview of the operating experience of the nuclear power industry, including comments about the trends of some key performance measures. The report also includes the principal findings and issues identified in AEOD studies over the past year and summarizes information from Licensee Event Reports, Diagnostic Evaluations, and reports to the NRC's Operations Center. NUREG-1272, Vol.3, No.2, covers Nonreactors and presents a review of the nonreactor events and misadministrations that were reported in 1988 and a brief synopsis of AEOD studies published in 1988. Each volume contains a list of the AEOD reports issued for 1980–1988.

38245 (WHC-SA–0510) **Overview of the site safeguards and security planning process.** Hensley, W.F.; Lehman, W.B.; Billings, M.P.; Goodey, K.O. Westinghouse Hanford Co., Richland, WA (USA). Jun 1989. 7p. Sponsored by DOE Defense Programs. DOE Contract AC06-87RL10930. (CONF-890736–44: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, FL, USA, 9-12 Jul 1989). Order Number DE89014949/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Site Safeguards and Security Plans are an extension of the US Department of Energy Master Safeguards and Security Agreement program, which has been in existence since 1985. Responsibilities and authorities for development of Site Safeguards and Security Plans and Master Safeguards and Security Agreements are provided by US Department of Energy Orders 5630.11, 5630.13 and 5630.14. Guidance for preparation of Master Safeguards and Security Agreements and Site Safeguards and Security Plans is provided by these Orders, a Preparation Guide, training sessions, and workshops. Under the Master Safeguards and Security Agreement program, a "contract" is established between US Department of Energy-Headquarters and each US Department of Energy regional Operations Office regarding protection strategies, protection system performance, and acceptability of risks for safeguards and security interests at a facility or site. Several changes in document format and content are introduced by the transition from Master Safeguards and Security Agreements to Site Safeguards and Security Plans. This report describes the processes involved in risk evaluation, risk acceptance, and upgrade identification: the protocol for interfacing with DOE-HQ Offices throughout SSSP development and approval phases; and a summary of various activities conducted by DOE-HQ to facilitate SSSP preparation. 4 refs., 2 figs., 1 tab.

38246 (WHC-SA–0523) **Nuclear material tracking system testing.** White, W.F.; Eggers, R.F.; Pardis, R.J. Westinghouse Hanford Co., Richland, WA (USA). Jun 1989. 10p. Sponsored by DOE Defense Programs. (CONF-890736–46: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, FL (USA), 9-12 Jul 1989). Order Number DE89014959/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A concept for a Nuclear Material Tracking System (NTRAK) and details of its operation have been developed at the Westinghouse Hanford Company. The NTRAK development is sponsored by the US Department of Energy (DOE). The NTRAK system is intended to help nuclear facilities meet the performance requirements of DOE Order 5633.3[1] and provide greater tracking capability and flexibility than is provided by current special nuclear material detection systems. The NTRAK testing, during its first year of development, is designed to verify concept feasibility, provide basic detection probability information of the NTRAK Detection Probability Prediction Program (NPROB), and verify detection probabilities predicted by NPROB. This paper reports on the results of testing accomplished in fiscal year 1988 and part of 1989. 3 refs., 12 figs.

38247 (WHC-SA–0524) **Nuclear material tracking system measurement concept and applications.** Eggers, R.F.; Emon, D.E.; Williams, T.L. Westinghouse Hanford Co., Richland, WA (USA). Jun 1989. 8p. Sponsored by DOE Defense Programs. DOE Contract AC06-87RL10930. (CONF-890736–48: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, FL, USA, 9-12 Jul 1989). Order Number DE89014956/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A concept for a Nuclear Material Tracking System (NTRAK) and details of its operation have been developed at the Westinghouse Hanford Company. The NTRAK uses multiple nuclear radiation detectors in special configuration to detect and triangulate the position of localized sources of special nuclear material. Once the position of the material is determined, its quantity can also be estimated. This is accomplished using the calibration equations of the detectors and additional information about the nature of the source. Currently, work is being carried out with NaI(Tl) gamma radiation detectors that are shielded with lead on all sides except the front face. This paper describes the theory of NTRAK operation and outlines some of its potential applications to nuclear material control. 3 refs., 3 figs., 2 tabs.

38248 (WHC-SA–0525) **Computer model for predicting nuclear material tracking system performance.** Giese, E.W.; Eggers, R.F. Westinghouse Hanford Co., Richland, WA (USA). Jun 1989. 8p. Sponsored by DOE Defense Programs. DOE Contract AC06-87RL10930. (CONF-890736–47: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, FL (USA), 9-12 Jul 1989). Order Number DE89014958/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The NPROB is a nuclear-material tracking system, computer simulation program. The NPROB is being developed under the Nuclear Material Tracking System Program sponsored by the US Department of Energy (DOE). The NPROB predicts the probability that a Nuclear Material Tracking System composed of one or more nuclear radiation detectors will detect an unauthorized movement of special nuclear material (SNM) inside a nuclear facility. The NPROB simulates the performance and system alarm logic of nuclear radiation detectors installed along process aisles and plant corridors near processing and storage areas. 3 refs., 4 figs., 3 tabs.

0560 Legislation and Regulations

Refer also to citation(s) 38107, 38108, 38111, 38186, 38194, 38195, 38197, 38198, 38200, 38201, 38202, 38203, 38204, 38205, 38214, 38233, 38244, 38492

38249 (BNL–52203) **Statutes for enforcement by security inspectors.** Cadwell, J.J. Brookhaven National Lab., Upton, NY (USA). Sep 1988. 13p. Sponsored by DOE Defense Programs. DOE Contract AC02-76CH00016. Order Number DE89014408/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The following security violations and enforcement by security personnel are briefly discussed: selected enforcement provisions of the Atomic Energy Act covering communication, receipt of and tampering with restricted data, trespass upon Commission installations, photographing, etc., of Commission installations, sabotage, misrepresentation of impersonation, theft and embezzlement, malicious mischief, conspiracy, searches and seizures, civil disorders, definitions (explosives), penalties (use of explosives or fire), concealment, removal, or mutilation, generally, arson, special maritime and territorial jurisdiction of the United States defined, and arson within special maritime and territorial jurisdiction.

38250 (CONF-8810239–Absts., pp. 1.3) **Capitol hill perspective on environmental compliance at Federal facilities.** Edelstein, J. (House of Representatives, Washington, DC (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; Gaithersburg, MD, USA; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

In recent months, Congress has held several hearing on Federal facility compliance with environmental requirements. Federal agencies, particularly the DOE, have not had a sympathetic reception by Congress. Federal facilities are generally perceived as scofflaws, being described by some members of Congress as the worst polluters. In addition, environmental groups have been very effective in using the media to create a poor image of DOE with the public and Congress. This unfavorable political climate may result in tougher environmental legislation applicable to Federal facilities when, in reality, a more reasonable approach may be required. For example, there are currently five new bills being considered by Congress dealing with Federal facility compliance including one which will

make EPA the ultimate enforcer over DOE environmental problems. Because of the current political climate, DOE is at a critical juncture in proving to Congress that environmental protection is equal in importance to the DOE's other missions. Just complying with existing environmental requirements, however, is not enough. Even when in compliance, debates over past problems reflect on current actions. DOE must develop more credibility in its environmental compliance programs to avoid unnecessary legislation. The DOE must devise ways of being responsive to Congressional inquires. There are several ways to accomplish this task. Environmental audits have been favorably reviewed by Congress as the basis for Congressional oversight of Federal facility compliance. Clean-up problems should be openly identified and established early. Finally, DOE must demonstrate its willingness to comply.

38251 (CONF-8810239–Absts., pp. 1.5) **EPA perspective on federal facility agreements.** Grundler, C. (Environmental Protection Agency, Washington, DC (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; Gaithersburg, MD, USA; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

Although DOE's image with Congress and the media concerning environmental compliance may be poor, EPA sees the Department's recent attitude toward the environment as good. DOE and EPA must continue to move forward. In particular, EPA would like to emphasize less study of a problem and more clean-up. Strong, enforceable agreements will allow this goal to be met by letting EPA take more risks in its decision making. Currently EPA is developing an enforcement strategy for Federal facilities. This strategy will address identifying Federal facilities of concern, increasing enforcement and compliance monitoring activities at those facilities, implementing the model agreements, resource planning, and the establishment of an Agency Management System for Federal facilities. There are over 1000 Federal facilities which are listed on the EPA compliance docket. Over 200 Federal facilities are expected to be included on the NPL. Increased EPA attention may increase the ability of the various Federal agencies to obtain the necessary funding. Another subject being addressed by EPA is the liability of government contractors under the environmental statutes. The Agency is developing a GoCo enforcement strategy. In the hazardous waste enforcement program, three criteria are being considered for determining when to proceed against a contractor: Degree of contractor control over the hazardous waste management activity. Who is actually performing the work, and Degree of Departmental cooperation.

38252 (CONF-8810239–Absts., pp. 1.25) **NRC residual radioactivity release criteria.** Neuder, S.M. (Nuclear Regulatory Commission, Washington, DC (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; Gaithersburg, MD, USA; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

The US Nuclear Regulatory Commission is expanding its current policy on the release of residual radioactivity for unrestricted use. With the development and promulgation of the Decommission Rule Amendments in June 1988, the Commission recognized the urgent need to develop further guidance and expanded radiological criteria regarding acceptable levels of radioactive contamination for unrestricted release of lands, structures, materials, and equipment. The expanded criteria are intended to provide additional guidance to licensees in planning for decontamination and decommissioning activities and to ensure a uniform approach and consistent decisions in agency determinations of unrestricted release of low levels of radioactivity. The expanded guidance, being generically developed on a dose-risk basis, will be consistent with the revised does system recommended by the International Commission on Radiological Protection and with the revised regulations in 10 CFR 20. The expanded guidance will also be consistent with the proposed Commission Policy Statement on Exemptions from Regulatory Control for Practices Whose Public Health and Safety Impacts Are Below Regulatory Concern. The guidance will be developed in two phases. The first phase will address the release of residually radioactive land and structures for unrestricted use while the second will address the release of residually radioactive tools and equipment and the recycle of other materials. In each case, the radiological criteria will be developed for volumetric as well as surface contamination, on an isotope-by-isotope basis.

38253 (CONF-8810239–Absts., pp. 2.45-2.62) **Department of the Army Installation Restoration Program.** Anderson, A.W. (Army Toxic and Hazardous Materials Agency, Aberdeen, MD (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; Gaithersburg, MD, USA; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

The Army's Installation Restoration Program (IRP) was established in 1975 in response to regulatory action at several installations where past disposal practices had caused contamination of streams and groundwater. The need to decontaminate excess Army-owned real estate also was considered in early IRP activities. A variety of site types have been discovered on Army installations. The major site types evaluated to date include: contaminated soil areas, landfills, lagoons, buildings, burning grounds, sumps, pits, storage tanks, sewage treatment plants, storage pads, industrial wastewater treatment plants, and salvage yards. Twenty Army installations have been proposed for or listed on the National Priorities List (NPL). The need for taking action at hazardous waste sites, however, is based on threats they pose to human health, welfare or the environment. Sites do not have to be on the SPL in order to be cleaned up through IRP activities. All of the sites that caused Army installations to be proposed for the NPL are being evaluated and cleaned up. In addition, all Army properties have been or will be assessed and where needed they will be addressed by the IRP.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

38254 (INIS-mf–11440, pp. 361) **Temperature dependence of the D_2O structure by thermal neutron diffraction.** Padureanu, I.S. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering); Rapeanu, S.N.; Ion, M.; Kozlov, J.A. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Neutron diffraction measurements on liquid heavy water have been performed at diiferent temperatures at VVR-S reactor, IPNE-Bucharest. (authors).

0702 Radiation Sources

Refer also to citation(s) 39675, 39739

38255 (GANIL-A–88-04) **Industrial applications of heavy ions beams at GANIL.** Bieth, C.; Van Den Bossche, M.; Busardo, D.; Balanzat, E.; Meslage, J.; Pierrard, P. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1988. 3p. Order Number DE89791993/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

After a year of research and development, BSI and GANIL started an industrial production of microporous membranes. The status of the technical and commercial problems is given. With the collaboration of indutrial firms, other applications are studied, like: non reflecting surfaces, ion implantation, surface treatment, radiation damage.

38256 (INIS-mf–11448, pp. 41) **Fast neutron irradiation facilities at ANSTO - SNIF.** Dytlewski, N. (Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia)); Boldeman, J.; Cohen, D.D.; Lavin, M.F. Australian Inst. of Nuclear

Science and Engineering, Lucas Heights (Australia). 1987. (CONF-8708339–: 11. AINSE radiation biology conference, Lucas Heights, Australia, 24-25 Aug 1987). In *Conference handbook*. Order Number DE89616297/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

ANSTO/irradiation plants; ANSTO; IRRADIATION; NEUTRON BEAMS; NEUTRONS

38257 (OEFZS–4482) **Contribution to the conservation of archaeological finds consisting of organic fibrous material using radiation-curable impregnants.** Schaudy, R.; Slais, E.; Knoll, H. Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (Austria). Dec 1988. 9p. (In German). (CH–394/88). Order Number DE89631411/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Experiments for the consolidating conservation of cords and ropes with different fibre structures by the use of radiation-curable monomers and oligomers (resins) have been carried out with the aim to impart strength and flexibility to the fibre material. Suitable samples were soaked with selected impregnants, cured with gamma radiation, and then characterized by determining the monomer (resin) uptake and evaluating the appearance and the mechanical properties. Although the optical appearance and the mechanical strength as well as the flexibility were found to be excellent in many cases, the method can be recommended only with some restrictions for the treatment of archaeological finds due to its irreversibility. 7 refs., 3 tabs.

38258 Demonstration of x-ray holography with an x-ray laser. Trebes, J. (Lawrence Livermore National Lab., Univ. of California, P.O. Box 5508, Livermore, CA (US)); Brown, S.B.; Campbell, E.M.; Matthews, D.L.; Nilson, D.G.; Stone, G.F.; Whelan, D.A. v.v of High intensity laser-matter interactions. Campbell, E.M.; Baldis, H. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-8801117–: High intensity laser matter interactions, Los Angeles, CA, USA, 12-13 Jan 1988).

X-ray holography offers the potential for obtaining high resolution three-dimensional images of in vitro biological microstructures. Significant progress toward this goal has been achieved with holography systems using synchrotron x-ray sources and recently spatial resolutions as small as 40 nm have been demonstrated. These experiments required x-ray exposures of an hour or longer, which makes high spatial resolution difficult to achieve in live biological specimens because of blurring of the image. This blurring is caused by specimen motion and prohibits the imaging of dynamical processes within the specimen. A possible solution to this problem is to exploit the extremely high brightness and long coherence lengths produced by x-ray lasers and create the hologram with exposure times of less than 1 nsec. This report presents the results from an experiment in which an x-ray laser was used to produce x-ray holograms. The holography geometry used was a Gabor in-line type modified by the inclusion of a high reflectivity multi-layer x-ray mirror used as a narrow bandpass filter.

0703 Isotopic Power Supplies

38259 (LA–11574) **General-purpose heat source development: Extended series test program SRB fragment/fuselage tests.** Cull, T.A. Los Alamos National Lab., NM (USA). Jun 1989. 15p. Sponsored by DOE Nuclear Energy. DOE Contract W-7405-ENG-36. Order Number DE89014389/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

General-Purpose Heat Source radioisotope thermoelectric generators (GPHS-RTGs) will provide electrical power for the NASA Galileo and European Space Agency (ESA) Ulysses missions. Each GPHS-RTG comprises two major components: GPHS modules, which provide thermal energy, and a thermoelectric converter, which converts the thermal energy into electrical power. Each of the 18 GPHS modules in a GPHS-RTG contains four $^{238}PuO_2$-fueled capsules. LANL conducted a series of safety verification tests on the GPHS-RTG before the scheduled May 1986 launch of the Galileo spacecraft to assess the ability of the GPHS modules to contain plutonia in potential accident environments. As a result of the Challenger 51-L accident in January 1986, NASA postponed the launch of Galileo; the spacecraft launch vehicle was reconfigured and the spacecraft trajectory modified. These actions prompted NASA to reevaluate potential mission accidents and the extended series safety test program was initiated. This program included a series of solid rocket booster (SRB) fragment/fuselage tests that simulated the interaction of SRB fragments generated in an SRB motor case rupture (or resulting from a range safety officer SRB destruct action) with sections of the Shuttle Orbiter. The test data helped verify and refine the analytical models of the SRB fragment/fuselage interaction. The results showed that the fragment velocity decreased significantly (up to 40%) after penetrating the Orbiter section(s). The interactions also reduced, and in some cases eliminated, the original fragment rotational rate and direction and initiated rotation in other directions. 5 refs., 11 figs., 2 tabs.

08 HYDROGEN

0801 Production

38260 (BNL–42228-Rev.) **An option for the coal industry in utilizing fossil fuel resources with reduced CO_2 emissions: Revision.** Steinberg, M. Brookhaven National Lab., Upton, NY (USA). May 1989. 27p. Sponsored by DOE Fossil Energy. DOE Contract AC02-76CH00016. Order Number DE89015021/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We developed a process for separating the hydrogen from the carbon in the coal, and disposing of the oxygen and the small amounts of sulfur and nitrogen and the ash as inert material. The process produces carbon black. It is presently and has for a long time been produced from residual oil and gas. Our carbon from coal process is called HYDROCARB. It is based on two well-known chemical reactions. The first reaction involves the hydrogenation of coal to form methane gas, and the second reaction thermally decomposes the methane to carbon black and hydrogen, part of which is recycled. In this cyclical process, there is no need for additional hydrogen, but rather hydrogen is produced as a co-product. The small amount of oxygen in the coal is removed either as water or as CO_2. Carbon black can be burned in a clean manner in stationary power plants or when mixed with water, gasoline, oil or even methanol, it can be pumped as a liquid mix which can be burned in diesel engines, turbines and even in internal combustion engines. Since it does not contain any ash, sulfur or nitrogen, it burns cleanly; the only product being CO_2. However, the HYDROCARB Process is very efficient requiring a very small net amount of energy, much less than any coal gasification or liquefaction process. Thus, much less total CO_2will be formed when burning carbon black than burning the inefficient coal-derived synthetic hydrocarbon fuels. 11 refs., 1 fig., 5 tabs.

38261 The solar energy research institute hydrogen fuel program. Smith, C. (Technology Development Associates (US)). v.v of Proceedings of the hydrogen photo-production workshop. Seki, A.; Morgan, B.; Takahashi, P. Hawaii Natural Energy Institute University of Hawaii at Manoa, Honolulu, HI (1987). (CONF-8703273–: PICHTR hydrogen photo-production workshop, Kailua-Kona, HI, USA, 25-26 Mar 1987).

This paper provides an overview of hydrogen research at the Solar Energy Research Institute (SERI), including efforts in photobiology, photochemistry, and photoelectricity. SERI's photoconversion research most directly relating to hydrogen includes photoelectrochemical studies of semiconductors as photon collectors, investigations on photosynthetic bacteria as producers of hydrogen from organic wastes, and research on hydrogenase and nitrogenase enzyme systems. Studies of the photosystem II type reactions are vital to developing an understanding of the natural water splitting process which produces the protons needed for hydrogen production. In the longer term, an appropriate donor-acceptor molecule may be a component of a synthetic water splitting hydrogen process.

38262 A technology status assessment of hydrogen from renewable energy. Block, D. (Florida Solar Energy Center (US)); Browne, S. v.v of Proceedings of the hydrogen photo-production workshop. Seki, A.; Morgan, B.; Takahashi, P. Hawaii Natural Energy Institute University of Hawaii at Manoa, Honolulu, HI (1987).

(CONF-8703273--: PICHTR hydrogen photo-production workshop, Kailua-Kona, HI, USA, 25-26 Mar 1987).

This paper reviews the cooperative research project on production and utilization of hydrogen from renewable resources performed by the Florida Solar Energy Center and the Hawaii Natural Energy Institute. The project was funded by the Solar Energy Research Institute and the U.S. Department of Energy. The objectives of the study were to conduct a technology assessment for evaluating the potential of renewable energy-produced hydrogen fuel, to investigate the assimilation of renewable energy-produced hydrogen into an overall energy economy, and to identify technologies and the research and development needed to provide such an option. The research was conducted during the 1986 calendar year.

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

Refer also to citation(s) 38998, 39218

38263 (ORNL/Sub--84-90435/1, pp. 2-18) **Fuel oils from Euphorbs and other plants.** Calvin, M. Oak Ridge National Lab., TN (USA); Lawrence Berkeley Lab., CA (USA). Aug 1988. In *Hydrocarbons and energy from plants. Final report, 1984-1987.* Order Number DE88015328/JAW. Available from NTIS, PC A08/MF A01.

The increasing energy costs of finding petroleum, together with the sure knowledge that its supply is finite, has prompted us to seek other sources of liquid hydrocarbon for both fuel and material. We have turned to annually renewable plant sources such as seed oils, an obvious source, with palm oil as the most productive. Sugar cane used to produce ethanol is another fuel source already in use. We have examined non-food plants which can be grown on marginal soil for their productivity, particularly the genus Euphorbia. All species of this genus produce a latex which can be converted into useful fuel and other material, including precursors for what might be a valuable anti-tumor agent. Euphorbias and other similar plants require repeated planting and harvesting of the entire plant, which constitutes a drain on the soil. Trees can be long-term sources for hydrocarbon-like materials with a single planting. Examples are; the genus Copaifera which can be tapped for sesquiterpenes; the genus Pittosporum which bears fruits rich in terpenes and can be harvested annually. Finally, there are algae whose oil productivity is already of interest. It seems possible to modify genetically the terpene biosynthetic pathways in plants to improve both the quality and quantity of the oils produced from them.

38264 (ORNL/Sub--84-90435/1, pp. 19-24) **Energy content of biomass: calculation from elemental composition.** Otvos, J.W. Oak Ridge National Lab., TN (USA); Lawrence Berkeley Lab., CA (USA). Aug 1988. In *Hydrocarbons and energy from plants. Final report, 1984-1987.* Order Number DE88015328/JAW. Available from NTIS, PC A08/MF A01.

The heat of combustion, or energy content, of an organic compound or mixture can be estimated with reasonable accuracy from the elemental composition alone. The R-value of the fuel, which equals the number of grams of oxygen needed to burn a gram of fuel, times the factor 3.34 gives the specific heat of combustion in kilocalories per gram.

38265 (ORNL/Sub--84-90435/1, pp. 25-41) **Triterpenoid biosynthesis in Euphorbia lathyris latex associated with a vacuole.** Skrukrud, C.L.; Taylor, S.E.; Hawkins, D.R.; Nemethy, E.K.; Calvin, M. Oak Ridge National Lab., TN (USA); Lawrence Berkeley Lab., CA (USA). Aug 1988. In *Hydrocarbons and energy from plants. Final report, 1984-1987.* Order Number DE88015328/JAW. Available from NTIS, PC A08/MF A01.

Latex isolated from Euphorbia lathyris laticifer cells maintains its ability to synthesize triterpenols (and their esters) from acetate. When the latex is centrifugated at 5000 xg for 15 min., this biosynthetic activity can be subdivided into two separate fractions: the acetate to mevalonic acid activity remains in the supernatant, while the mevalonic acid to triterpenol activity is pelleted. Further purification of the pellet by isopycnic centrifugation on Percoll gradients yielded a particle responsible for the conversion of mevalonic acid to triterpenol. Electron microscopy of this particle and comparison with marker enzyme activity indicated that this organelle is a vacuole.

38266 (ORNL/Sub--84-90435/1, pp. 42-45) **Triterpenols of Euphorbia lathyris latex.** Hawkins, D.R.; Nemethy, E.K.; Calvin, M. Oak Ridge National Lab., TN (USA); Lawrence Berkeley Lab., CA (USA). Aug 1988. In *Hydrocarbons and energy from plants. Final report, 1984-1987.* Order Number DE88015328/JAW. Available from NTIS, PC A08/MF A01.

The triterpenols of the latex of Euphorbia lathyris have been isolated and identified by spectroscopic methods as euphol, lanosterol, cycloartenol, 24-methylenecycloartenol, 24-methylenelanosterol, and butyrospermol.

38267 (ORNL/Sub--84-90435/1, pp. 46-54) **Additional physiological studies of the laticifer cell.** Taylor, S.E.; Nemethy, E.K.; Skrukrud, C.L.; Hawkins, D.R.; Calvin, M. Oak Ridge National Lab., TN (USA); Lawrence Berkeley Lab., CA (USA). Aug 1988. In *Hydrocarbons and energy from plants. Final report, 1984-1987.* Order Number DE88015328/JAW. Available from NTIS, PC A08/MF A01.

The role of S-adenosyl methionine, fructose 2,6-bis phosphate, and Mn^{++} in the physiology of Euphorbia lathyris laticifer cell has been investigated. S-adenosyl methoinine was found to play a role in the biosynthesis of the fatty acid esters of the triterpenois. Addition of fructose 2,6-bis phosphate to isolated latex increased triterpenoid production from glucose. The addition of Mn^{++} to isolated latex resulted in a doubling of the rate of triterperoid biosysthesis.

38268 (ORNL/Sub--84-90435/1, pp. 55-77) **Hydroxymethyl glutaryl-coenzyme a reductase activity in latex.** Skrukrud, C.L.; Calvin, M. Oak Ridge National Lab., TN (USA); Lawrence Berkeley Lab., CA (USA). Aug 1988. In *Hydrocarbons and energy from plants. Final report, 1984-1987.* Order Number DE88015328/JAW. Available from NTIS, PC A08/MF A01.

Biosynthesis of triterpenoids (triterpene esters and triterpenols) by isolated latex of Euphorbia lathyris was investigated. The rate of in vivo incorporation of mevalonic acid into the triterpenoids was 30x greater than that of acetate incorporation (0.55 vs. 0.02 nmol 100μl latex^{-1} h^{-1}), indicating that the rate limiting step in the pathway occurs prior to mevalonate conversion. Both HMG-CoA reductase and HMG-CoA lyase activities were detected in isolated latex. HMG-CoA reductase was localized to a membrane-bound fraction of a 5000 xg pellet. The rate of conversion of HMG-CoA to mevalonate by this enzyme (0.02 nmol 100μl latex^{-1} h^{-1}) was comparable to the overall rate of acetate incorporation into the triterpenoids, indicating that this enzyme is rate-determining in the biosynthesis of the latex terpenoids.

38269 (ORNL/Sub--84-90435/1, pp. 95-105) **Effect of salinity on the allocation of carbon to energy-rich compounds in Euphorbia lathyris.** Taylor, S.E.; Skrukrud, C.; Calvin, M. Oak Ridge National Lab., TN (USA); Lawrence Berkeley Lab., CA (USA). Aug 1988. In *Hydrocarbons and energy from plants. Final report, 1984-1987.* Order Number DE88015328/JAW. Available from NTIS, PC A08/MF A01.

Hydroponically-grown Euphorbia lathyris plants were exposed to increasing levels of NaCl to study the effect of salinity on carbon allocation within the plant. Salinization caused a decrease in overall growth, and an increase in the production of both hydrocarbons and sugars. The hydrocarbon fraction, containing mostly triterpenoids, increased by 50%, and the sugar fraction, containing mostly sucrose, was increased by 88%. This resulted in a shift of available biomass from lignocellulose to the more usable sugars and hydrocarbons. A 2-fold increase in the activity (per leaf area) of the enzyme β-Hydroxymethyl-glutaryl-Coenzyme A Reductase was also observed with increased salinity. This enzyme is involved in the biosyntheses of triterpenoids, and its response to increased salinity indicates a role for this enzyme in the regulation of plant hydrocarbon productivity.

38270 (ORNL/Sub--84-90435/1, pp. 114-119) **Lignans of Myristica otoba.** Nemethy, E.K.; Lago, R.; Hawkins, D.R.; Calvin, M. Oak Ridge National Lab., TN (USA); Lawrence Berkeley Lab.,

CA (USA). Aug 1988. In *Hydrocarbons and energy from plants. Final report, 1984-1987.* Order Number DE88015328/JAW. Available from NTIS, PC A08/MF A01.

The neutral fraction of the oil of Myristica otoba fruits afforded a series of seven lignans of the aryltetralin type. Myristica otoba fruits were collected in Panama. The shells were removed, the fruits cut into small pieces and extracted with CH_2Cl_2 for 4 hr at room temperature. After removal of solvent, a viscous oil, 74% of the fresh weight, was obtained. Silica gel chromatography eluting with hexane, hexane-CH_2Cl_2, hexane-ethyl ether, ethyl ether and CH_3Cl-methanol (97:3) yielded a glyceride fraction (86% of the oil) and a neutral fraction (14%). The neutral fraction was separated into two components by silica gel chromatography, eluting with hexane, hexane-ethyl ether (100:1 to 1:1) and CH_3Cl-methanol (1:1). Fraction I (20% of the neutral fraction) eluted with hexane-ethyl ether (19:1) and had a R_f = 0.41 on silica gel TLC with hexane-ethyl ether (1:1). Fraction II (40%) eluted from the column with hexane-ethyl ether (4:1), and had a Rf = 0.24 on TLC. Fractions I and II were resolved into individual compounds by HPLC using an Altex 5 μ ODS column with a mobile phase of methanol-water (3:1). Compound 3 was further purified from a minor, isomeric compound on a 5 μ Altex SiO2 column, using hexane-ethyl ether (87:13) as the mobile phase. The ^1H NMR spectra were recorded at 250 and 500 MHz in $CDCl_3$ with TMS as the internal standard. Coupling constants, where appropriate, were determined by decoupling experiments. The MS data were collected at 70 eV; high resolution data were within 5 ppm of calculated values. The CD spectra were taken in methanol.

38271 (ORNL/Sub–84-90435/1, pp. 120-136) **Biosynthesis of terpenoids in Copaifera.** Skrukrud, C.L.; Calvin, M. Oak Ridge National Lab., TN (USA); Lawrence Berkeley Lab., CA (USA). Aug 1988. In *Hydrocarbons and energy from plants. Final report, 1984-1987.* Order Number DE88015328/JAW. Available from NTIS, PC A08/MF A01.

Studies of the incorporation of various precursors into leaf discs and cuttings show differences in the rate of incorporation into sesquiterpenes and the other isoprenoids, suggesting either a controlling mechanism or parallel pathways.

38272 (ORNL/Sub–84-90435/1, pp. 137-145) **Composition of the steam distillate of Pittosporum resiniferum and of the seed oils of Myristica otoba and macauba palm (Acrocomia sclercarpa).** Taylor, S.E.; Lago, R.; Nemethy, E.K.; Otvos, J.W.; Calvin, M. Oak Ridge National Lab., TN (USA); Lawrence Berkeley Lab., CA (USA). Aug 1988. In *Hydrocarbons and energy from plants. Final report, 1984-1987.* Order Number DE88015328/JAW. Available from NTIS, PC A08/MF A01.

A steam distillate of Pittosporum resiniferum fruits was found to contain alkanes and monoterpenes. Seed oils were collected from Myristica otaba and Macauba Palm fruits and were fractionated into the triglyceride and non-saponifiable components. The fatty acid composition of the triglycerides was then determined.

38273 A combined chemical and biological process for methane production from cellulosic solids. Tsai, G.J. (Lab. of Renewable Resources Engineering, Potter Engineering Center, Purdue Univ., West Lafayette, IN (US)); Tsao, G.T. v.v of Energy from biomass and wastes XI. Klass, D.L. Institute of Gas Technology, Chicago, IL (1988). (CONF-870364–: 11. IGT conference on energy from biomass and wastes, Orlando, FL, USA, 16-20 Mar 1987).

Cooking of cellulosic materials at high pH due to added alkali converts most of the carbohydrates to organic acids. Mixtures of the calcium salts of the organic acids can be readily fermented in an anaerobic fluidized bed digester to generate methane gas. The overall process residence time is about 2 days. This report describes the preliminary experimental set up and some results.

38274 Novel two-phase upflow digestion of wet-carbonized peat product water. Sajjad, A. (Institute of Gas Technology, Chicago, IL (US)); Henry, M.P.; Srivastava, V.J.; Mensinger, J. v.v of Energy from biomass and wastes XI. Klass, D.L. Institute of Gas Technology, Chicago, IL (1988). (CONF-870364–: 11. IGT conference on energy from biomass and wastes, Orlando, FL, USA, 16-20 Mar 1987).

This paper presents the development and operating results of a novel two-phase upflow anaerobic digestion process for the bioconversion of organic matter present in the process effluent generated during the wet-carbonization processing of peat. It exhibited a methane yield of 3.0 SCF/lb chemical oxygen demand (COD) added during thermophilic (55°C) digestion at a short hydraulic retention time of (HRT) 3 days. This yield represents approximately 90% of the ultimate methane yield for this process effluent. About 80% of the feed biological oxygen demand (BOD) and 65% of COD was converted during the anaerobic digestion process. This innovative process has a substantive beneficial impact on the production of net energy and availability of surplus digester methane for conversion to other energy forms such as hot water or low-pressure steam for in-process use.

38275 Oxidative dimerization of methane over lithium-promoted zinc oxide. Zhang, H.S. (Texas A & M Univ., College Station (USA)); Wang, J.X.; Driscoll, D.J.; Lunsford, J.H. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 242-248 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

The heterogeneously catalyzed oxidative dimerization of methane has received considerable attention in recent years. A variety of material have now been examined which include the main group oxides, the rate-earth oxides and a number of doped transition and main group metal oxides. Work in this laboratory has focused primarily on the latter materials, and in particular Li-doped MgO. Over this material it is postulated that methane is activated via hydrogen atom abstraction by (Li^+O^-) centers which are present under reaction conditions on the surface of the catalyst. Subsequent steps in the mechanism involve the release of these radicals from the surface into the homogeneous gas phase where they then undergo coupling reactions to produce the selective C_2 products. The formation of (Li^+O^-) centers has also been reported on Li-doped ZnO. This material is considered to be a non-basic semiconductor, whereas, MgO is considered to be a basic insulator. Li-doped ZnO was chosen for examination not only because of its ability to produce potentially active centers, but also to determine the effect of basicity on the catalytic properties. Recent work by Matsuura et al. has shown that this material is indeed active for the oxidative dimerization of methane. In the present study, this material will be examined in further detail in an effort to identify the active site on the catalyst surface and to determine the overall mechanism for final product formation.

38276 Catalytic partial oxidation of methane to higher hydrocarbons. Tyler, R.J. (CSIRO Division of Fossil Fuels, North Ryde (Australia)); Lukey, C.A. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 249-254 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

The direct conversion of methane to higher hydrocarbons such as ethylene is currently a very active research area. Olefins are of particular importance as they represent intermediates suitable for oligomerization to transport fuels. Li-doped magnesia is notable in that it does not contain metal ions of variable oxidation state and the active species is thought to involve the anion. A remarkable feature of the published data is the variety of surfaces that promote the reaction and the similarity of many of the reported product distributions. This suggests that after the initiation step the hydrocarbon building steps probably occur via a gas phase mechanism. The present paper reports results obtained using a Li/MgO catalyst with CH_4/O_2 mixtures and describes the influence of contact time and oxygen concentration on reaction rate and product selectivities. Implications for the reaction mechanism are also discussed.

38277 Methane polymerization using a hollow cathode. Meubus, P. (Ministry of Energy, Mines and Resources, Ottawa, Ontario (Canada)); Jean, G. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 260-265 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

The polymerization of methane, or other low-molecular weight hydrocarbons, in the presence of electrical discharges or in low temperature plasmas, has been the subject of a large number of reports

in the literature. Common features are the operation under vacuum and the production of radicals diffusing towards the reactor wall with subsequent polymerization to a solid product. The gas phase is generally composed of hydrocarbons up to C_5. The polymerization of hydrocarbons can be initiated through the positive-ion molecule type reaction and the radical molecule type reaction. The hollow cathode is a medium of high interest for generating a large concentration of highly energetic electrons, leading to the possible formation of CH_4 + ions. Preliminary results obtained in this lab have shown that methane conversion can be effected using a hollow cathode as the source of polymer initiators. The present work investigates the effects on the process of the cathode metal used (Tungsten, Tantalum and a Tungsten-Platinum solid solution) as well as the influence on the yield of the gas used as a diluent (argon and helium).

38278 **Alkane activation by oxide-supported organorhodium complexes.** Schwarta, J. (Princeton Univ., NJ (USA)). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 286-290 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

Homogeneous catalysis, or catalysis by discrete, soluble transition metal complexes, is dominated by studies of such species in soft ligand environments (e.g., consisting of phosphines, sulfides or carbonyls). Historically, one focus of research in this field has been the elucidation of changes in reactivity of a complex which are effected by subtle modification of the ligand environment of the metallic center. It is of interest to us to determine how a gross change in this ligand environment affects the reactivity of a metal system bound to it; specifically, we aim to elucidate changes in rules of molecular reactivity which occur when the soft ligand environment of a transition metal complex is replaced by a hard, oxygen-based ligation.

38279 **Activation of methane on iron, nickel, and platinum surfaces: a molecular orbital study.** Anderson, A.B. (Case Western Reserve Univ., Cleveland, OH (USA)); Maloney, J.J. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 291-298 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

The activation of alkane CH bonds is the first step in hydrogenolysis and oxidation catalysis. It is clear from simple consideration of metal-hydrogen bond strengths (~/<250kJ/mol) and CH bond strengths (434 kJ/mol for breaking the first CH bond in methane) that oxidative addition and not hydrogen atom abstraction will be the route followed on metal surfaces. In contract, O^- defect centers at oxide surfaces do abstract hydrogen atoms from methane, forming gas phase methyl radicals. The greater strength of an OH bond over a CH bond allows this to happen; a molecular orbital analysis has been published recently. Though kinetic studies of alkane reactions on metal surfaces are large in number, little is known about catalyst surface composition and structure or the structure and electronic factors responsible for CH activation by metals. The purpose of the present work is to explore mechanisms, activation energies, and orbital interactions associated with the oxidative addition of a methane CH bond to several idealized clean transition metal surfaces.

38280 **Conversion of CH_4 into C_2H_4 by the chlorine-catalyzed oxidative-pyrolysis (CCOP) process. I. Oxidative pyrolysis of CH_3Cl.** Granada, A. (Illinois Institute of Technology, Chicago (USA)); Karra, S.B.; Senkan, S.M. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 299-306 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

Methane is available in large quantities in natural gas, thus constitutes an important raw material for the synthesis of higher molecular weight hydrocarbons. Processes exist to convert methane into acetylene, ethylene, and hydrogen using high temperature pyrolysis. However, at the high temperatures needed for the thermal decomposition of methane, the yields of more valuable liquid and gaseous products are too low due to the formation of excessive amounts of carbonaceous solids. In an earlier patent Gorin proposed a chlorine-catalyzed process in which methane conversion was achieved via CH_4 chlorination, followed by the pyrolysis of chlorinated methanes (CM) and formation of C_{2+} products and HCl. The HCl produced can either be converted into chlorine via the well-known Deacon reaction, or can be used to convert CH_4 into CH_3Cl via oxychlorination process, thus completing the catalytic cycle for chlorine. Recently, Benson patented a process similar to that of Gorin, in which the flame reactions of Cl_2 and CH_4 were involved. Later, Weissman and Benson studied the kinetics of CH_3Cl pyrolysis. The mechanism of the oxidative pyrolysis of CH_3Cl is the topic of this study. The Chlorine-Catalyzed Oxidative-Pyrolysis (CCOP) process developed ameliorates the problem of formation of solid products, while maintaining high yields for acetylene and ethylene. The CCOP process exploits the high-temperature, non-flame reactions of methane, chlorine, and oxygen, and forms an important bridge between combustion chemistry, halogen inhibition processes and chemical reaction engineering. Although some carbon monoxide forms in the CCOP process, CO is a gaseous product thus can be handled easily. In addition, CO can itself be used to synthesize higher molecular hydrocarbons as well.

38281 **Conversion of methane to gasoline-range hydrocarbons.** Taylor, C.E. (Pittsburgh Energy Technology Center, PA (USA)); Noceti, R.P. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 307-314 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

Existing processes have been assembled in a novel combination capable of producing higher hydrocarbons from methane with high yield and selectivity. Methane, oxygen, and hydrogen chloride react over an oxyhydrochlorination (OHC) catalyst in the first stage to produce predominantly chloromethane and water. In the second stage, the chloromethane is catalytically converted to higher hydrocarbons, namely, paraffins, cycloparaffins, olefins, and aromatics, by an alumino-silicate zeolite. In the process described, the final hydrocarbon mixture is largely in the gasoline (C_4-C_{10}) boiling range. The first stage of the process has been carried out under varying conditions of temperature and residence times. The conversion of reactants, the yields, and the product selectivities are tabulated over the operating range of the catalyst. The second-stage reaction has been carried out utilizing feeds of chloromethane and various mixtures of chloromethane, dichloromethane, and trichloromethane. A long-term study on a commercial zeolite has shown no significant changes in conversions or product distribution after multiple regeneration cycle.

0902 Alcohol Fuels

38282 (DOE/PC/90013–T9) **Optimum catalytic process for alcohol fuels from syngas: Ninth quarterly technical progress report, January–March 1989.** Union Carbide Corp., South Charleston, WV (USA). Solvents and Coatings Materials Div. 28 Apr 1988. 29p. Sponsored by DOE Fossil Energy. DOE Contract AC22-86PC90013. Order Number DE89015817/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Work continues on optimizing higher alcohol catalysts consisting of transition metals supported on metal oxides with a spinel structure. First level studies focusing on identifying the best metal(s) to support and the best spinel components, using a Hyper-Greco-Latin Square experimental design, have been completed. The maximum yields predicted using the best combination of elements are still far below our goals, although the selectivities are good. However, it is anticipated that major gains in activity can be achieved by increasing the metal loading and by varying the atomic ratios of the metals used. A second level of experimentation, again using a statistically designed set of experiments, has been initiated to explore the metal ratios, to evaluate some other potential spinel cations suggested by analogy with results obtained in the first designed set, and to determine if positive chemical effects can be obtained by using different techniques to introduce some of the components. The major emphasis in the reaction engineering arena during the past quarter was to support the conceptualization, design, and specification of equipment for the experimental continuous slurry reaction system. 3 refs., 5 figs., 5 tabs.

38283 (GAO/RCED–87-91) **Alternative fuels.** General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. 1988. 12p. Available from General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Army initiated the methanol vehicle demonstration program to establish the feasibility of using methanol as an alternative fuel for government vehicles. Army had difficulty obtaining new methanol vehicles because manufacturers were unwilling to provide the number needed for the program. Because of budget limitations the program was unable to test enough vehicles for a sufficient number of miles to decisively establish reliability and durability. The Army is examining methanol vehicle operation under cold, moderate, and hot climate conditions, but results will not be available until October 1987. In addressing support functions, the Army developed methanol fuel and lubricant specifications; methods for transporting, storing, and dispensing the fuel; and technical specifications for vehicle conversion. The program by itself contributed little to increasing the use of methanol fuel because the limited number of vehicles used did not encourage their methanol production or fuel distribution.

38284 The cost of making methanol available to a national market. McNutt, B. (US Dept. of Energy (US)); Dowd, J.; Holmes, J. v.v of Methanol. Society of Automotive Engineers, Warrendale, PA (1988). (CONF-8711216–: SAE meeting on methanol: promise and problems, Toronto, Canada, 2-5 Nov 1987).

Technical Paper 872063.

The U.S. Dept. of Energy has completed the first phase of its analysis of the components and cost of a methanol fuel compatible transportation infrastructure. This paper integrates the results of that analysis with other analyses on likely infrastructure and market development issues to estimate the cost of putting methanol fuel (M-85) in the marketplace. Unit and overall costs are estimated for various infrastructure components including fuel terminals, retail outlets and vehicles. The infrastructure costs are considered in the context of a methanol utilization scenario based on assumptions about future methanol and oil prices and consumer behavior. Methanol use is determined by the competitive economics but evolves within the developed infrastructure which is assumed to be driven by non-market forces.

38285 Economic and security issues of methanol supply. Difiglio, C. (Office of Policy Planning and Analysis, US Dept. of Energy (US)); Lawrence, M.F. v.v of Methanol. Society of Automotive Engineers, Warrendale, PA (1988). (CONF-8711216–: SAE meeting on methanol: promise and problems, Toronto, Canada, 2-5 Nov 1987).

Technical Paper 872062.

Use of methanol as a neat motor fuel has the potential to reduce U.S. oil imports and enhance U.S. energy security. The extent to which methanol use can achieve this potential depends on several economic and security issues that are discussed in this paper. The analytic framework under which methanol use is evaluated postulates the gradual introduction of fuel flexible vehicles so that, at some future date, a significant amount of gasoline use can be displaced by methanol. The benefits of using methanol are measured by the cost advantage methanol can provide over gasoline and the effect methanol use may have in reducing world oil prices. This paper summarizes current estimates of methanol cost in the short and long run and describes an ongoing analytic effort to understand the future methanol market in more detail.

38286 A review of methanol vehicles and air quality impacts. Moses, D. (Office of Environmental Analysis, U.S. Dept. of Energy (US)); Saricks, C. v.v of Methanol. Society of Automotive Engineers, Warrendale, PA (1988). (CONF-8711216–: SAE meeting on methanol: promise and problems, Toronto, Canada, 2-5 Nov 1987).

Technical Paper 872053.

In the quest for reduction of air pollution to target levels required under revised State Implementation Plans (SIPs), ozone nonattainment areas are investigating and committing to programs for accelerated fleet penetration of methanol- and fuel-flexible motor vehicles. In this paper the authors examine if the premises for these commitments are informed (whether sufficient evidence is in hand to assure that the air quality effects of replacing conventionally-fueled vehicles with alcohol-capable units are positive), and even if positive effects can be proved, whether they occur in time to be relevant to the developers of ozone SIP revisions.

38287 Direct conversion of methane to methanol by a high pressure partial oxidation reaction. Gesser, H.D. (Univ. of Manitoba, Winnipeg (Canada)); Hunter, N.R.; Morton, L.A.; Yarlagadda, P.S.; Fung, D.P.C. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA)*, 32(3): 255-259 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

The conversion of methane to a liquid storageable fuel is a desirable alternative to compressed natural gas. The simplest liquid is methanol presently formed by the steam reforming of methane to synthesis gas followed by the high pressure catalytic conversion of the synthesis gas to methanol. The process is most economic for large (2000 tonne/day) plants and must be located near large reserves of natural gas or near an appropriate pipeline. The simpler partial oxidation route offers the advantage of directly converting methane to methanol in a single step reaction. The potential for the partial oxidation route together with an economic evaluation has been reported by Edwards and Foster who showed that, provided the selectivity for methanol formation is about 77%, the partial oxidation route has an economic advantage over the conventional synthesis route with no penalty for conversions as low as 4%. Much has been published on the combustion of methane to CO_2 and H_2O but very little has been concerned with the intermediate formation of methanol. Gesser et al. recently reviewed the controlled oxidation of CH_4 to CH_3OH emphasizing the free radical mechanistic aspects. The heterogeneous catalytic studies was reviewed by Foster and Pitchai and Kleir. Although the literature indicated some potential catalysts no commercial viable reaction system has been developed. Before embarking on a study of the catalytic conversion of CH_4 to CH_3OH we attempted to establish a base-line study by examining the homogeneous reaction and here report a summary of the results with methane.

38288 Methane partial oxidation in alternating electric fields. Mallinson, R.G. (Univ. of Oklahoma, Norman (USA)); Sliepcevich, C.M.; Rusek, S. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA)*, 32(3): 266-271 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

In this work, methane and oxygen mixtures have been oxidized to form methanol and smaller amounts of formaldehyde, methyl formate, formic acid and ethanol. Substantial amounts of water are also produced, as well as a small amount of ethane. The oxidation takes place at ambient conditions of temperature and pressure in an alternating electric field which is generated between cylindrical plates with a gap of 0.060 inches. Conversions were linearly dependent on the RMS voltage in experiments using up to 10 kV RMS. Among square, triangular, and sinusoidal wave forms, only small differences in performance were observed over the range of frequencies studied, from 25 to 200 Hertz. The effects of oxygen concentration, space time, frequency, and field plate area have also been examined on a limited basis. The power consumption to the power supply has been measured to determine the efficiency of this system, in which substantial heat is released. The yield of methanol is from seven to nine percent of the methane converted in which methane conversions of five to ten percent are obtained when an oxygen limited feed is used. Substantial amounts of the methane converted appear as carbon monoxide and carbon dioxide, both of which are somewhat inhibited by operation with the oxygen limited feed, although product inhibition during recycle experiments was not observed.

38289 Testing of catalysts for alkane activation. Stohl, F.V. (Sandia National Laboratories, Albuquerque, NM (USA)); Shelnutt, J.A.; Granoff, B.; Trudell, D.E. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA)*, 32(3): 280-285 (1988). DOE Contract AC04-76DP00789. (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

Research is needed to find catalysts that are capable of oxidizing methane to methanol with high conversions and high selectivities. Porphyrins are being used as catalysts because they are present in enzymes that perform C_1 chemistry (methyl reductase, methyl transferase), have versatile structures that can be controlled, and can be

synthesized with many different metals. Porphyrins have also shown significant activity for oxidation of long chain alkanes (C5+).

0904 Solid Waste and Wood Fuels

Refer also to citation(s) 38273, 38303, 38700

38290 Are increased yields in coppice systems a myth. Wright, L.L. (Environmental Sciences Div., Oak Ridge National Lab., Oak Ridge, TN (US)). v.v of Energy from biomass and wastes XI. Klass, D.L. Institute of Gas Technology, Chicago, IL (1988). (CONF-870364–: 11. IGT conference on energy from biomass and wastes, Orlando, FL, USA, 16-20 Mar 1987).

Biomass yield data from the Department of Energy's Short Rotation Woody Crops Program suggest that minirotations (2 years or less) at best equal but do not exceed the productivity rate of short-rotation (3-10 years) intensively cultured hardwoods on an average annual basis. In trials where rotation lengths of 2 and 4 years were imposed, the 2-year rotation treatment resulted in total yields equal to or lower than the 4-year rotation treatment in 40 to 48 comparisons. Coppice systems with rotation lengths greater than 2 years and single rotation systems followed by replanting of genetically improved stock need to be considered as options for short-rotation, intensively cultured (SRIC) systems. SRIC should be designed to maximize biomass production by using proper weed control, selected species or clones, and optimum fertilizer and water for the most appropriate rotation length and density strategy.

38291 The effect of salinity on the allocation of carbon to energy-rich compounds in Euphorbia lathyris. Taylor, S.E. (Lawrence Berkeley Lab. and Dept. of Chemistry, Univ. of California, Berkeley, CA (US)); Skrukrud, C.L.; Calvin, M. v.v of Energy from biomass and wastes XI. Klass, D.L. Institute of Gas Technology, Chicago, IL (1988). (CONF-870364–: 11. IGT conference on energy from biomass and wastes, Orlando, FL, USA, 16-20 Mar 1987).

Hydroponically-grown Euphorbia lathyris plants were exposed to increasing levels of Nacl to study the effect of salinity on carbon allocation within the plant. Salinization caused a decrease in overall growth and an increase in the percentage of both hydrocarbons and sugars. The hydrocarbon fraction, containing mostly triterpenoids, increased by 50% and the sugar fraction, containing mostly sucrose, was increased by 88%. This resulted in a shift of available biomass from lignocellulose to the more usable sugars and hydrocarbons.

14 SOLAR ENERGY

1405 Solar Energy Conversion

Refer also to citation(s) 38262, 38263, 38264, 38265, 38266, 38267, 38268, 38269, 38270, 38271, 38272, 38273, 38274, 38290, 38291, 38899, 38900, 38901, 39185, 39210

38292 (CONF-8905146–3) **Photosynthetic model systems that address the role of superexchange in electron transfer reactions.** Wasielewski, M.R.; Niemczyk, M.P.; Johnson, D.G.; Svec, W.A.; Minsek, D.W. Argonne National Lab., IL (USA). 1989. 14p. Sponsored by DOE Energy Research. DOE Contract W-31109-ENG-38. From 22. Jerusalem symposium on quantum chemistry; Jerusalem (Israel); 15-18 May 1989. Order Number DE89015701/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Four fixed-distance porphyrin-quinone molecules, 1-syn, 1-anti, 2-syn, and 2-anti, were synthesized. These molecules possess a zinc 5 phenyl-10,15,20-tripentylporphyrin electron donor attached to a naphthoquinone via a rigid pentiptycene spacer. The central benzene ring of the spacer is unsubstituted in 1 and possesses p-dimethoxy substituents in 2. The naphthoquinone is oriented either syn or anti to the porphyrin across the spacer. These molecules provide information concerning the orientation dependence of electron transfer between the porphyrin and the quinone, and the dependence of this transfer on low-lying ionic states of the spacer. 34 refs., 7 figs., 2 tabs.

38293 (LBL–24018, pp. 13-16) **Photosynthesis reactions.** Sauer, K.; Klein, M.P. Lawrence Berkeley Lab., CA (USA). Sep 1987. In *Chemical Biodynamics Division: Annual report, October 1, 1986-September 30, 1987.* Order Number DE88004886/JAW. Available from NTIS, PC A04/MF A01.

Photosynthetic light reactions constitute the principal biological energy source derived from sunlight. We are carrying out spectroscopic and other biophysical studies aimed at understanding the mechanism of photon capture and excitation transfer among photosynthetic pigments, the earliest steps in conversion to chemical potential by electron transfer in the reaction centers and the mechanism of water oxidation to O_2. Both kinetic and structural investigations are carried out using a variety of spectroscopic techniques, including optical absorption and fluorescence, electron paramagnetic resonance (EPR) and X-ray spectroscopy. In related studies we are looking at the composition and organization of the photosynthetic complexes and their arrangement in the thylakoid membranes. We have also investigated model compounds designed to simulate the light-induced electron transfer that lies at the heart of the photosynthetic energy conversion.

38294 (LBL–24018, pp. 20-22) **Tissue-specific expression of Ri T-DNA genes in Nicotiana tabacum.** Leach, F.; Bartholomew, J.C. Lawrence Berkeley Lab., CA (USA). Sep 1987. In *Chemical Biodynamics Division: Annual report, October 1, 1986-September 30, 1987.* Order Number DE88004886/JAW. Available from NTIS, PC A04/MF A01.

The project has been designed to identify cytoplasmic factors which are responsible for specific gene expression in two different plant tissues: leaves and roots. Only a few instances of proteins controlling the activity of plant promoters by binding to upstream DNA sequences, just like in bacteria and in mammalian cells, have been identified. This has been the case in the control of zein gene expression. The study of how transcription is controlled in plants is crucial in an era in which plant genetic engineering is becoming possible. It is essential that any foreign gene which is introduced in plant tissues can be expressed in a regulated manner if desired.

38295 (ORNL/Sub–84-90435/1, pp. 78-94) **Location and solubilization of hydroxymethyl glutaryl-coenzyme a reductase from extracts of Euphorbia lathyris stem and leaf tissue.** Skrukrud, C.L.; Calvin, M. Oak Ridge National Lab., TN (USA); Lawrence Berkeley Lab., CA (USA). Aug 1988. In *Hydrocarbons and energy from plants. Final report, 1984-1987.* Order Number DE88015328/JAW. Available from NTIS, PC A08/MF A01.

The major portion of the HMG-CoA reductase activity of Euphorbia lathyris vegetative tissue was localized to a plastid fraction, while the highest specific activity was found in the mitochondrial fraction. Differences in the optimal pH for HMG-CoA reductase activity between the vegetative and latex tissues suggests that isozymes of this enzyme may be present in the two tissue types.

38296 (PNL–6828, pp. 2.1-2.21) **Assessing the persistence of recombinant bacteria in microcosms.** Armstrong, J.L. (Environmental Protection Agency, Corvallis, OR (USA)). Pacific Northwest Lab., Richland, WA (USA). Feb 1989. In *Evaluation of terrestrial microcosms for detection, fate, and survival analysis of genetically engineered microorganisms and their recombinant genetic material.* Order Number DE89008479/JAW. Available from NTIS, PC A08/MF A01.

The objective of this paper is to discuss effective use of microcosms as tools for genetically engineered microorganisms (GEM) studies. Therefore, an emphasis is placed on materials and methods, supplemented with several examples of applications. Included are descriptions of microbiological techniques for obtaining and processing microcosm samples from two microcosm designs that differ in methodological complexity.

38297 (PNL–6828, pp. 3.1-3.23) **Fate of recombinant pseudomonads in modified soil-core microcosms (Versacores).** Jansson, J.K. (Michigan State Univ., East Lansing (USA)); Holben, W.E.; Tiedje, J.M.; Chelm, B.K. Pacific Northwest Lab., Richland, WA (USA). Feb 1989. In *Evaluation of terrestrial microcosms for detection, fate, and survival analysis of genetically engineered microorganisms and their recombinant genetic material.* Order Number DE89008479/JAW. Available from NTIS, PC A08/MF A01.

The soil core represents the most convenient, realistic microcosm of the soil microorganism environment, and is thus the most logical approach for establishing a method to assess the fate and behavior of genetically engineered microorganisms. The core maintains the natural nutrients supply and the physical relationships, including competition, among indigenous organisms. It can also support plants, is easily used in rainfall and leaching studies, and is convenient for use in the laboratory. Thus, the objective of this study was to refine and test a soil-core system for studying the fate of introduced genetically engineered microorganisms. Because of this versatility of this core, designed to allow several modes of organism introduction as well as analysis, we have named it Versacore. Pseudomonas species were chosen as the engineered organisms used to evaluate the Versacore design because of their importance in agronomic and biodegradation applications. Pseudomonas cepacia PCO1224 and PCO1215 (R388::Tn904) are being considered by the U.S. Environmental Protection Agency as potential benchmark strains for evaluating and standardizing assessment methodology. Pseudomonas sp. B8 is an aggressive root-colonizing, toxin-producing microorganism that inhibits growth of winter wheat. Engineered derivatives of Pseudomonas cepacia PCO1224 and Pseudomonas sp. B8, in addition to the plasmid-containing strain, P. cepacia PCO1215 (R388::Tn904), were used as model organisms in this study. The Versacore was used to evaluate survival and dissemination of recombinant pseudomonads from the point of inoculation to different depths of the core in the presence and absence of plants.

38298 (PNL–6828, pp. 4.23-4.40) **Fate of root growth-inhibiting Pseudomonas sp.Tn5 mutants in intact soil-core microcosms.** Fredrickson, J.K. (Pacific Northwest Lab., Richland, WA (USA)); Bolton, H. Jr.; Li, S.W.; Van Voris, P.; Bentjen, S.A. Pacific Northwest Lab., Richland, WA (USA). Feb 1989. In *Evaluation of terrestrial microcosms for detection, fate, and survival analysis of genetically engineered microorganisms and their recombinant genetic material.* Order Number DE89008479/JAW. Available from NTIS, PC A08/MF A01.

The specific objectives of this study were to measure the colonization of Pseudomonas sp. Tn5 tox+ and tox- phenotypes in the wheat rhizoplane, rhizosphere, and bulk soil with depth; determine the potential for transport of the introduced bacteria through the intact soil cores with percolating water and root growth; determine the potential for antagonism of several physiological groups of rhizosphere bacteria; and to determine if earthworms can serve as vectors of the introduced bacteria in soil. These experiments indicate that intact soil cores may have utility for assessing the fate and potential ecosystem impacts from the release of genetically engineered microorganisms to the environment.

38299 (PNL–6828, pp. 4.3-4.22) **Intact soil-core microcosms for evaluating the fate and survival of genetically engineered microorganisms in the environment.** Bentjen, S.A. (Univ. of Idaho, Moscow (USA)); Fredrickson, J.K.; Van Voris, P.; Li, S.W. Pacific Northwest Lab., Richland, WA (USA). Feb 1989. In *Evaluation of terrestrial microcosms for detection, fate, and survival analysis of genetically engineered microorganisms and their recombinant genetic material.* Order Number DE89008479/JAW. Available from NTIS, PC A08/MF A01.

Intact soil-core microcosms were studied to determine their applicability for evaluating the transport, survival, and potential ecosystem effects of genetically engineered microorganisms before they are released into the environment. Microcosms were planted with wheat and maize seeds and inoculated with Azospirillum lipoferum SpBr17 and SpRG20a Tn5 mutants, respectively. Heat-killed cells served as controls. Above-ground plant biomass and leaf tissue nitrogen were measured to determine inoculation effects on plant growth. Microcosm leachate, rhizosphere soil, plant endorhizosphere, and xylem exudate were sampled for A. lipoferum Tn5 populations. Aphids and European corn borers were evaluated as potential vectors for A. lipoferum Tn5 dissemination. Whole pGS9 DNA probe hybridized to non-Azospirillum colonies in leachate, necessitating the use of a more specific DNA probe constructed from the nptII region of Tn5. Azospirillum lipoferum Tn5 populations, determined by most-probable-number DNA hybridization, varied from undetectable to 10^5 per gram of dry root in the rhizosphere, with smaller populations detected in the endorhizosphere. Maize plants with established A. lipoferum Tn5 populations populations had higher nitrogen concentrations, but plant yield was unaffected. Rhizosphere populations of nitrifying bacteria and Rhizobium were unaffected by inoculation with A. lipoferum Tn5 mutants. These results indicate that microcosms maintain a high degree of ecosystem complexity and can serve as a representative model system to examine transmission through the ecosystem, rhizosphere and endorhizosphere colonization, potential displacement of other rhizosphere microorganisms, and effects on plant growth by genetically engineered microorganisms.

38300 (PNL–6828, pp. 5.23-5.43) **Enumeration of Tn5 mutant bacteria in soil by MPN-DNA hybridization and antibiotic resistance.** Fredrickson, J.K. (Pacific Northwest Laboratory, Richland, WA (USA)); Li, S.W.; Bezdicek, D.F.; Brockman, F.J. Pacific Northwest Lab., Richland, WA (USA). Feb 1989. In *Evaluation of terrestrial microcosms for detection, fate, and survival analysis of genetically engineered microorganisms and their recombinant genetic material.* Order Number DE89008479/JAW. Available from NTIS, PC A08/MF A01.

In this paper we compare several methods for detecting bacteria in soil and assess the utility of the transposable element Tn5 as a phenotypic marker in microbial ecology experiments. In addition, a quantitative DNA hybridization procedure for detection of unique genotypes in soils using most-probable-number (MPN) analysis is presented, which may be applicable to the detection and enumeration of genetically engineered microorganisms intended for release to the environment.

38301 (SAND–89-1311C) **Pool boiler reflux solar receiver for Stirling dish-electric systems.** Andraka, C.E.; Moreno, J.B. Sandia National Labs., Albuquerque, NM (USA). 1989. 12p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. (CONF-890815–3: 24. intersociety energy conversion engineering conference, Washington, DC, USA, 7-12 Aug 1989). Order Number DE89011842/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

The feasibility of competitive, modular bulk electric power from the sun may be greatly enhanced by the use of a reflux heat pipe receiver to combine a heat engine such as Stirling with a paraboloidal dish concentrator. This combination represents a potential improvement over previous successful demonstrations of dish-electric technology in terms of enhanced performance, lower cost, longer life, and greater flexibility in engine design. There are, however, important issues and unknowns which must be addressed to determine engineering feasibility of these devices. In the pool boiler reflux receiver, concentrated solar radiation causes liquid metal (sodium or potassium) to boil. The vapor flows to the engine heater heads, where it condenses and releases the latent heat. The condensate is returned to the receiver absorber pool by gravity (refluxing). This is essentially an adaptation of heat pipe technology to the peculiar requirements of concentrated solar flux, and provides many advantages over conventional heated tube receiver technology. Boiling theory indicates that long-term stable boiling of liquid metal may be difficult to achieve. Laboratory scale experiments have been performed. Initial tests confirmed that boiling is unstable in a baseline boiler. Boiling stability was established after the addition of "artificial cavities" to the heated surface, and successful boiling of sodium was demonstrated for 100 hours. Other stabilizing influences may have been present, and will be discussed. The flux and geometry closely simulated a real receiver. The results of these tests are presented, along with the design of a full scale receiver for on-sun testing and considerations for long term operation. 15 refs., 10 figs.

38302 (SERI/TP–211-3501) **Thin film photovoltaics.** Zweibel, K.; Ullal, H.S. Solar Energy Research Inst., Golden, CO (USA). May 1989. 7p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. (CONF-890815–4: 24. intersociety energy conversion engineering conference, Washington, DC, USA, 7-12 Aug 1989). Order Number DE89009425/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Thin films are considered a potentially attractive technological approach to making cost-effective electricity by photovoltaics. Over the last twenty years, many have been investigated and some (cadmium telluride, copper indium diselenide, amorphous silicon) have become

leading candidates for future large-scale commercialization. This paper surveys the past development of these key thin films and gives their status and future prospects. In all cases, significant progress toward cost-effective PV electricity has been made. If this progress continues, it appears that thin film PV could provide electricity that is competitive for summer daytime peaking power requirements by the middle of the 1990s; and electricity in a range that is competitive with fossil fuel costs (i.e., 6 cents/kilowatt-hour) should be available from PV around the turn of the century. 22 refs., 9 figs.

38303 Cyclone reactor. Converse, A.O.; Grethlein, H.E.; Holland, J.E. To Dept. of Energy, Washington, DC. USA Patent 4,818,295. 4 Apr 1989. Filed date 4 Apr 1986. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

A system is provided to produce sugars from a liquid-solid mixture containing biomass, and an acid, wherein the mixture is heated to an appropriate temperature to achieve hydrolysis. The liquid-solid mixture is introduced as a stream into the circular-cylindrical chamber of a cyclone reaction vessel and steam is introduced to the vessel to provide the necessary heat for hydrolysis as well as to establish the liquid-solid mixture in a rotary flow field whereby the liquids and solids of the mixture move along spiral paths within the chamber. The liquid-solid mixture may be introduced at the periphery of the chamber to spiral down toward and be discharged at or near the center of the chamber. Because of differing mass, the solid particles in the mixture move radially inward at a different rate than the liquid and that rate is controlled to maximize the hydrolysis of the solids and to minimize the decomposition of sugars, thus formed.

1406 Photovoltaic Power Systems

Refer also to citation(s) 38465

38304 (ILR-Mitt.–198(1988)) **Systems analysis and design of a lunar solar power station for supply of a lunar base.** Joehenning, B.; Britsch, M.; Dust, R.; Grade, M.; Grasme, M.; Greiner-Petter, J.; Jacubiec, W.; Leppich, J.; Luebke-Ossenbeck, B.; Mayer, J. Technische Univ. Berlin (Germany, F.R.). Inst. fuer Luft- und Raumfahrt. 8 Jun 1988. 46p. (In German). Available from Technische Univ. Berlin (Germany, F.R.). Inst. fuer Luft- und Raumfahrt.

This report contains the preliminary design and cost estimates of a lunar solar power station for supply of a lunar base. A power demand at lunar day of 7.5 MW and 2.5 MW at lunar night as well as photovoltaic power conversion were assumed. Out of the various design options the authors selected the option with least sum of procurement and space transportation cost. The facility consists of 228 sun-following solar generators equipped with GaAs-Cells (concentration ratio = 10) and 15 fuel cell/electrolysis cell units with kryogenic storage of hydrogen and oxygen. Total system mass including power conversion and distribution is estimated to be about 1 170 metric tons. Power output of the solar generators will be 17.8 MW. This results in an overall power conversion efficiency of 9.6 percent. Acquisition cost of the total system will be about 4.4×10^9 Dollar (1987) assuming specific transportation cost of 2 000 Dollar/kg (1987) to the Moon. During the 30 years operational period the life cycle cost will amount to about 10.6×10^9 Dollar (1987) which results in mean lunar energy cost of about 8.5 Dollar/kWh. (orig.).

38305 (SAND–88-2974) **Field tests of a novel inverter for photovoltaic power conditioning.** Dickerson, A.; Bower, W.; Schalles, F. Sandia National Labs., Albuquerque, NM (USA). May 1989. 58p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. Order Number DE89014322/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The Dickerson inverter synthesizes a sinewave current from a photovoltaic array that is segmented into a number of subarrays. These subarrays are switched among the ac phases so that the current from a given subarray is continuous, and each phase is connected at all times to one or more subarrays. The control scheme assures a near-unity power factor current with real-time phase adjustment to power-system disturbances. A prototype inverter was operated into a three-phase power system, with the dc supplied by a photovoltaic array at Sandia National Laboratories. The results of these tests under normal, abnormal and fault conditions are reported. Inversion efficiencies up to 99% were achieved with 0.97 power factor. A simple filter reduced current harmonics from 18% to 5%. The performance for the inverter was projected for a 480-V, three-phase system at the 50-kVA level. An analysis of filtering costs indicates that harmonic reduction to 5% can be achieved at under $0.003 per watt for typical central-station applications. The intended power range for these inverters is 50–250 kVA. The cost to produce the inverter at the 50-kVA level in quantities of 1000 units is estimated to be $0.05 per watt, which is less than the projected cost of other 50-kVA inverters. 22 figs., 9 tabs.

1407 Solar Thermal Power Systems

Refer also to citation(s) 38312

38306 (DOE/AL/25034–T1) **Osage City SCSE [Small Community Solar Experiment]: Final report.** Hunt, J.W. Barber-Nichols Engineering Co., Arvada, CO (USA). Jun 1989. 207p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FC04-84AL25034. Order Number DE89014772/JAW. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

In February, 1984, Barber-Nichols Engineering Company proposed to provide a 100 kW solar-electric power generating system at Osage City, Kansas. The proposal was made in response to Department of Energy Proposal Opportunity Notice DE-PN04-84AL25034. The proposal was a joint effort by Barber-Nichols and Power Kinetics, Inc. of Troy, New York in which Barber-Nichols, as prime contractor, would supply the Rankine engine, and PKI would provide the point focusing solar collector. The program was intended to demonstrate a Small Community Solar Thermal Power system. The program had four main goals: (1) to demonstrate the operation and performance of a module at the Sandia Test Facility, (2) to construct the 100 kW plant at Osage City, Kansas and place it in service, and (3) to operate the system successfully for a period of one year, and (4) turn the system over to the Osage City Electric Company for future operation. This report covers the Rankine engine design and development, electrical power system inverter, engine testing on collector, solar collector development and testing, and component failures.

38307 (SAND–88-3286C) **Testing of the STM4-120 kinematic Stirling engine for solar thermal electric systems.** Linker, K.L.; Adkins, D.R.; Rawlinson, K.S. Sandia National Labs., Albuquerque, NM (USA). 1989. 12p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. (CONF-890815–14: 24. intersociety energy conversion engineering conference, Washington, DC, USA, 7-12 Aug 1989). Order Number DE89013933/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Department of Energy's (DOE) Solar Thermal Program has identified the Stirling cycle heat engine as the conversion device for dish-electric system with the most potential for meeting the program's goals for efficiency, reliability, and installed cost. In an effort to advance the technology toward commercialization, Sandia National Laboratories has recently acquired a Stirling Thermal Motors, Inc. (STM) kinematic Stirling engine, STM4-120, for evaluation. The engine is being bench tested at Sandia's Engine Test Facility (ETF) and will be combined later with a solar receiver for on-sun evaluation. This paper presents the bench-test approach including: test system layout, instrumentation controls, testing parameters, and preliminary performance results for the STM4-120. 3 refs., 6 figs.

38308 (SAND–89-1248) **A bibliography of reports from the solar thermal distributed receiver systems project at Sandia National Laboratories.** Leonard, J.A.; Poore, A.V. (eds.). Sandia National Labs., Albuquerque, NM (USA). Jun 1989. 75p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89014321/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The research and development described in this document were conducted within the US Department of Energy's Solar Thermal Technology Program. The goal of the Solar Thermal Technology Program is to advance the engineering and scientific understanding of solar thermal technology and to establish the technology base from which private industry can develop solar thermal power production options for introduction into the competitive energy market. This bibliography cites, with a few additions, all the documents that

were published by, or sponsored by, Sandia National Laboratories in support of the Department of Energy's Solar Thermal Technology Program and its Distributed Receiver Project. The timing of this updated bibliography is important because it marks the end of an era in which distributed receiver and central receiver research and development were pursued separately. At the beginning of fiscal year 1989, the Department of Energy initiated a restructured solar thermal research and development strategy. The new program is mission oriented, with core technology development activities supporting the missions. For instance, the advanced electric technology mission has an objective to organize industry, user, and government consortia that will field competitive next-generation solar thermal electric system experiments within five years–regardless of whether the systems are distributed or central receivers; and the concentrator development core activity will develop optical materials and concentrators regardless of application.

38309 (SAND–89-1349C) **Recommendations for improvements in the design and operation of future solar central receiver power plants based on experience gained from the Solar One Pilot Plant.** Kolb, G.J. Sandia National Labs., Albuquerque, NM (USA). 1989. 6p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. (CONF-890815–13: 24. intersociety energy conversion engineering conference, Washington, DC (USA), 7-12 Aug 1989). Order Number DE89014627/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Solar One Pilot Plant successfully demonstrated the feasibility of solar central receiver power plants. During its operating years much data were collected regarding the efficiency and availability of the various plant systems. This paper summarizes these statistics and compares them to goals developed by the Department of Energy. Based on this comparison, design and operation improvements are recommended so that future central receiver plants can more closely attain these goals. 9 refs., 4 figs., 1 tab.

38310 (SAND–89-1474C) **Development and testing of advanced central receivers.** Chavez, J.M. Sandia National Labs., Albuquerque, NM (USA). 1989. 7p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. (CONF-890815–11: 24. intersociety energy conversion engineering conference, Washington, DC, USA, 7-12 Aug 1989). Order Number DE89013498/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Advanced central receiver concepts are currently being investigated as part of the US Department of Energy solar thermal research program. In the last 12 years many studies and test programs have been carried out to develop and demonstrate the viability of central receiver power plants using the tube-receivers with molten-nitrate-salt and steam. However, studies of advanced receiver concepts, such as the molten nitrate salt direct absorption receivers and volumetric air receivers, have shown their potential to be simpler and cheaper than conventional tube-receivers. In a direct absorption receiver, the heat-absorbing fluid (a blackened molten nitrate salt) flows in a thin, wavy film down a flat, vertical panel (rather than through tubes) and absorbs the concentrated solar flux directly. The volumetric air receiver design uses a porous absorber, on which the solar energy is concentrated. Air flows through the absorber, convectively transferring energy from the absorber to the air. In this paper, the concepts, advantages, status, and test results of both the direct absorption receiver and the volumetric receiver are discussed. 16 refs., 7 figs.

1409 Solar Thermal Utilization

Refer also to citation(s) 38308

38311 (DOE/SF/11950–T8) **Research on the control of active solar space conditioning systems, Phase 2: Volume 1, Summary of objectives and accomplishments: Final report.** Herczfeld, P.R.; Fischl, R.; Helferty, J.J. Drexel Univ., Philadelphia, PA (USA). Dept. of Electrical and Computer Engineering. Jul 1986. 43p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC03-83SF11950. Order Number DE89015464/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The overall goal of the investigations performed under the present contract on the Control of Solar Cooling Systems is to improve the performance and cost effectiveness of such active systems by developing alternate control strategies. More specifically, the objectives under Phase 1 and Phase 2 of this program were: to develop accurate, analytic dynamic models for the various components of the active solar cooling system, namely the collector, the transport pipes, the storage, the chiller, and the load; to develop efficient, analytic techniques which combine these components into an integrated system; to validate experimentally the component models at the CSU test facility; to validate the entire interconnected system on CSU house III, the experimental test facility; and to develop preliminary control strategies which can be both simulated on our control programs and also validated at the CSU test facility. Accurate, dynamic models were developed for the collector, the pipes, storage, the chiller and the various interfaces. All these dynamic models were documented in the report submitted at the conclusion of Phase 1 of this project. A brief summary of the context of that report is given in Appendices A, B and C of this volume (Volume 1). Appendix A summarizes the dynamic models of the components which are contained in the solar collector loop, while Appendix B summarizes the dynamic model of the chiller. Appendix C summarizes the structure and status of the CAD software for control system design. 4 refs.

38312 **Solar engineering - 1988.** Murphy, L.M.; Mancini, T.R. 553p. American Society of Mechanical Engineers, New York, NY (1988). (CONF-880457–: 10. annual American Society of Mechanical Engineers solar energy conference, Denver, CO, USA, 10-14 Apr 1988).

This book contains 74 selections. Some of the topics are: Testing and measurements; fundamentals of solar energy systems; solar ponds; alternative heating and cooling technologies; central receivers; distributed receiver systems; solar dynamic space power; and energy conversion in buildings.

1410 Solar Collectors and Concentrators

Refer also to citation(s) 38308, 38312

38313 (SAND–88-3426C) **Development of concentrating collectors for solar thermal systems.** Holmes, J.T.; Alpert, D.J.; Mancini, T.R.; Murphy, L.M.; Schissel, P.O. Sandia National Labs., Albuquerque, NM (USA). 1989. 8p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789;AC02-83CH10093. (CONF-890815–10: 24. intersociety energy conversion engineering conference, Washington, DC, USA, 7-12 Aug 1989). Order Number DE89013088/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Concentrating solar collectors are required to generate the elevated temperatures that can be used to efficiently power industrial and electric conversion processes. The development and improvement of cost effective, highly innovative, heliostats and parabolic dish collectors, and supporting design and materials research are reviewed. 28 refs., 8 figs., 1 tab.

38314 (SAND–89-7029) **Use of imaging refractive secondaries in photovoltaic concentrators.** James L.W. Sandia National Labs., Albuquerque, NM (USA). Jul 1989. 55p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. Order Number DE89014376/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

A new type of secondary optical element for two-axis photovoltaic solar concentrator systems is described. This optical system is known as the double-imaging concentrator system because the sun is imaged by the primary Fresnel lens onto the secondary lens, and the primary lens is imaged by the secondary lens onto the cell. The secondary lens can take two forms. An egg-shaped (ellipsoidal) glass secondary is suspended above the cell in one implementation. The alternative configuration, called the SILO secondary, allows gluing the secondary lens directly to the cell. The SILO lens is a glass cylinder or cone with a molded half-ellipsoidal top surface. In both cases, the fact that the primary lens is imaged onto the cell means that if the primary lens is uniformly illuminated, then the cell is uniformly illuminated, independent of first-order of tracking errors, mounting errors, and primary Fresnel lens aberrations.

Monte Carlo ray trace modeling of these systems with the "FgImgSec" computer code shows significant advantages over other optical systems in the important areas of photon flux uniformity over the solar cell surface, and maximum allowable mounting and aiming tolerances. Parametric studies of concentration ratio and primary lens f-number show the limits in system design and give guidance for system optimization. 2 refs., 44 figs.

1420 Heat Storage

38315 (ITL–8509, pp. 295-299) **Validation of duct-store models with experimental data from the Groningen project.** Wijsman, A.J. (TNO Inst. of Applied Physics, Delft, The Netherlands); van Meurs, G.A.M. Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, Toronto, Canada, 22-26 Sep 1985;MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In Groningen, The Netherlands, a project with seasonal heat storage of solar heat in the upper layer of the soil has been realized. The seasonal heat store in the soil consists of a layer of soil in which the vertical tube heat exchanger is inserted. Only the top of the store is furnished with an insulation layer. Experimental data gathered from testing the system were used for the validation of the various computer models for the seasonal heat store. Some of the models describe the global heat transfer process in and around the heat store. Others take the local heat transfer process around the heat exchanger tubes into account. In this paper the various computer models for the seasonal heat store are described and the results of the validation work are given. 3 refs., 10 figs.

38316 (ITL–8509, pp. 213-217) **Experimental study of transfers of mass and energy above a heat storage in unsaturated soil.** Benet, J.C. (Univ. des Sciences et Techniques du Languedoc, Montpellier, France); Saix, C.; Jouanna, P. Intertask Ltd., Ottawa, ON (Canada). 1985. (In French). (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, Toronto, Canada, 22-26 Sep 1985;MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A large-scale physical model was used to study the unsaturated layer of soil overlying a solar energy earth storage facility. The storage zone was simulated by a concrete tank containing saturated sand. The temperature of the tank was maintained at 60°C to simulate heat storage. The layer of unsaturated soil 3 m thick was placed on top of the tank, with vertically installed sensors. Storage did not affect water equilibrium in the soil. No overpressure of the gaseous phase or significant compaction was recorded. The only two parameters changed by the storage were temperature and partial pressure of water. Atmospheric conditions were felt only in a superficial layer about 70 cm thick and did not affect the storage yield. The flow calculations show that vertical transfers of water and water vapor as a result of the storage were minor. Energy transfers took place essentially by thermal conduction. A mathematical model was prepared for practical forecasting of profiles of water content and temperature in the storage site. It also gave access to the yield of the process. In a first approximation, there is agreement between the experimental and theoretical results. Application of the simplified model to storage at 60°C in a soil layer 3 m thick located 10 m below the surface of the ground suggests good yield for the process. 5 refs., 7 figs., 1 tab.

38317 (ITL–8509, pp. 364-374) **Central solar heating plants with seasonal storage. An international feasibility study.** Boysen, A. (Bengt Hidemark Goesta Danielson Arkitektkontor HB, Stockholm, Sweden). Intertask Ltd., Ottawa, ON (Canada). 1985. (In English and French). (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, Toronto, Canada, 22-26 Sep 1985;MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, Canada K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This paper presents some early results of a study of the cost-effectiveness of central solar heating plants with seasonal storage. The work started in 1980 as Task VII of the Solar Heating and Cooling Programme within the International Energy Agency. Task VII investigates systems which are mainly solar energy based (approximately 80%), and distribute the energy as sensible heat in water. The storage concept was also based on sensible heat in water, but quite soon also included those storage concepts where the ground itself, be it rock or clay, is used as the storage medium. 9 refs., 2 figs.

15 GEOTHERMAL ENERGY

1503 Geothermal Exploration and Exploration Technology

38318 (LA-UR–89-1640) **Prefeasibility geothermal assessment of Platanares, Department of Copan, Honduras.** Goff, S.; Goff, F.; Heiken, G.; Duffield, W.A.; Truesdell, A.H.; Laughlin, A.W.; Flores, W. Los Alamos National Lab., NM (USA). 1989. 11p. DOE Contract W-7405-ENG-36. (CONF-8903134–1: Circum-Pacific energy and minerals conference, San Jose, Costa Rica, 5-8 Mar 1989). Order Number DE89012611/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Platanares geothermal system is located in a region of active Quaternary tectonism in western Honduras. Although the geothermal area is partially blanketed by Miocene ignimbrites (14.5 m.y.), there are no nearby Quaternary volcanic rocks to act as a young magmatic heat source. No acid-sulfate waters, indicative of vapor-dominated conditions, exist in the area. Hot spring activity is most vigorous along a 2 km stretch of the Quebrada del Agua Caliente fault zone. Natural discharge is high (~3300 l/min), temperatures range from 35 to 100°C, pH ranges from 7 to 9, and totally dissolved solids are low (~1100 mg/kg). Chemical geothermometers indicate a subsurface reservoir temperature of about 225°C. Three exploration core holes (7.8 cm diameter) have been drilled to a maximum depth of 680 m and maximum temperature of 165°C. Two holes produce copious amounts of water under artesian conditions (~500 l/min max; 5 bars flowing) from fractured red beds of Cretaceous to Eocene age (Valle de Angeles Group). Maximum power output is ~4.5 MW (thermal) but CO_2 released during flashing formed some aragonite scale in one hole. The third core hole has an "apparent" conductive gradient of 139°C/km at 400 m. Downward continuation of this gradient implies that the minimum depth to the geothermal resource (225°C) is 1.5 to 2.0 km. 13 refs., 4 figs.

1506 Environmental Aspects and Waste Disposal

Refer also to citation(s) 38319

1508 Geothermal Power Plants

38319 (EPRI-GS–6380) **Proceedings: Eleventh EPRI geothermal conference and workshop: Basis for expansion.** Hughes, E.; Roberts, V.; Kruger, P. Electric Power Research Inst., Palo Alto, CA (USA). c Jun 1989. 253p. Sponsored by Electric Power Research Institute. (CONF-8706162–: 11. EPRI geothermal conference and workshop: basis for expansion, Oakland, CA, USA, 23-25 Jun 1987). Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The Eleventh Annual EPRI Geothermal Conference and Workshop was held in Oakland, California, June 23–25, 1987. This volume contains the proceedings of the conference, the theme of

which was "Basis for Expansion." Technical sessions included presentations on EPRI research concerning wellhead power systems, upstream noncondensable gas removal, geothermal chemistry, the Heber Binary Project, downwell pump technology and flash crystallization for scale control. Other technical sessions included presentations by electric utility companies regarding their geothermal projects, by the US Department of Energy (DOE) on its geothermal program, and by DOE contractors on advanced geothermal source (magma energy and hot dry rock). A panel discussion followed by working group discussions focused on the conference theme, exploring how past, current and future research, development and commercial projects can provide the basis for the expansion of geothermal power generation in the United States. Technical papers, panelists' perspectives and workshop summaries are included in this volume.

1509 Geothermal Engineering

Refer also to citation(s) 38319

1510 Direct Energy Utilization

Refer also to citation(s) 38319

1520 Geothermal Data and Theory

38320 (LA-UR–89-1899) **Microscopic distribution of trace elements in minerals (chlorites, sulfides, sulfates) in submarine hydrothermal systems.** Janecky, D.R.; Benjamin, T.M.; Rogers, P.S.Z.; Bayhurst, G.K.; Haymon, R.M. Los Alamos National Lab., NM (USA). 1989. 4p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890878–1: 6. international symposium on water-rock interaction, Malvern, UK, 3-12 Aug 1989). Order Number DE89014238/JAW. Available from NTIS, PC A02/MF A01 - OSTI.

We have analyzed trace elements in two types of hydrothermal precipitates using the Los Alamos Nuclear Microprobe. Chlorites and epidotes in basalt were analyzed from the Samail Ophiolite of Oman. Sulfide and sulfate minerals were analyzed from samples of active chimney walls from 21°N. East Pacific Rise. These samples are ideal for our study because of the extensive background information available on processes and component characteristics. Initial results indicate significant differences in mobile trace elements between chlorites associated with and those distinctly separate from major stockwork flow zones, consistent with greater water-rock reaction within stockworks. Trace element concentrations across chimney walls also exhibit distinctive patterns which can be correlated with mineral/chemical zonation and possible also with variations in elemental source. 9 refs., 2 figs., 1 tab.

16 TIDAL AND WAVE POWER

1607 Tidal Power Plants

38321 (CONF-890819–18) **Experimental investigation of seawater biofouling for enhanced surfaces.** Panchal, C.B. Argonne National Lab., IL (USA). 1989. 26p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract W-31109-ENG-38. From ASME/AIChE national heat transfer conference; Philadelphia, PA, USA; 6-9 Aug 1989. Order Number DE89013281/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An experimental study is carried out to determine biofouling characteristics for enhanced surfaces. As a part of the OTEC biofouling project, two types of heat-transfer enhanced surfaces are used; spirally indented and fluted tubes. The experimental program is carried out at the Natural Energy Laboratory of Hawaii. The results are compared to plain-surface fouling data and key differences are identified. The experimental results show that for enhanced surfaces, the rate of fouling is comparable to that for plain surfaces. Moreover, the rate of chlorination required for maintaining the fouling resistance within an acceptable value is more-or-less the same. Manual brush cleaning and chlorination for removal of film of fouled surface is possible, provided excessive fouling buildup is not allowed. The interactive effects of thermal-hydraulic phenomena and fouling mechanisms are examined. The literature data are evaluated along with the present results to explain the fouling behavior of enhanced surfaces. 17 refs., 8 figs., 2 tabs.

17 WIND ENERGY

1704 Economics

38322 (GKSS–88/E/16) **On the energy output estimation of wind turbines.** Mengelkamp, H.T. GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). 1988. 12p. Available from Special print from Int. J. Energy Res. (1988) v. 12 p. 113-123.

During the operation of the German test field for small Wind Energy Conversion Systems (WECS) on the island of Pellworm five wind turbines were tested following recommendations of the International Energy Agency (IEA) expert group. Possible errors in the estimation of a tested wind turbine's total energy output at a potential installation site are investigated. Different wind speed frequency distributions (the measured one, the Rayleigh and the two-parameter Weibull distribution) are used to calculate the total energy output. The differences between the various distributions are mostly below 10 per cent. An improvement of the energy output estimate by a Weibull-instead of a Rayleigh distribution was not found. It is also shown that the use of the recommended 10 min averages or any other average overestimates the WECS' efficiency, up to 14 per cent on average depending on turbulence intensity. Wind power instead of wind speed is the appropriate parameter for power performance testing. Spectra of wind power and electrical power output show three areas of different correlation. A resistance length for wind turbines is shown to be dependent on the WECS operation status. (orig.).

1706 Wind Energy Engineering

38323 (SERI/TP–217-3506) **Data analysis method for wind turbine dynamic response testing.** Olsen, T.L.; Hock, S.M. Solar Energy Research Inst., Golden, CO (USA). Jun 1989. 6p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. (CONF-890815–8: 24. intersociety energy conversion engineering conference, Washington, DC, USA, 7-12 Aug 1989). Order Number DE89009417/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Wind Research Branch at the Solar Energy Research Institute (SERI) has developed an efficient data analysis package for personal computer use in response to growing needs of the wind turbine industry and SERI's Cooperative Field Test Program. This new software is used by field test engineers to examine wind turbine performance and loads during testing, as well as by data analysts for detailed post-processing. The Wind Data Analysis Tool Set, WINDATS, has been written as a collection of tools that fall into two general groups. First, the preparatory tools perform subsection, filtering, decimation, preaveraging, scaling, and derivation of new channels. Second, analysis tools are used for mean removal, linear detrending, azimuth averaging and removal, per-rev averaging, binning, and spectral analysis. The input data file can be a standard ASCII file as is generated by most data acquisition software. 9 refs., 10 figs.

38324 (SERI/TP–217-3515) **The probable source of certain spurious frequencies found in the output of a variable speed generating system using slip recovery.** Carlin, P.W. Solar Energy Research Inst., Golden, CO (USA). Jun 1989. 4p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. (CONF-890815–9: 24. intersociety energy conversion engineering conference, Washington, DC, USA, 7-12 Aug 1989). Order Number DE89009424/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

As part of US Department of Energy-sponsored research on wind energy, a Mod-O wind turbine was used to drive a variable-speed,

wound-rotor, induction generator. Energy resulting from the slip frequency voltage in the generator rotor was rectified to dc, inverted back to utility frequency ac, and injected into the power line. Spurious changing frequencies displayed in the generator output by a spectrum analyzer are caused by ripple on the dc link. No resonances of any of these moving frequencies were seen in spite of the presence of a bank of power factor correcting capacitors. 5 figs.

20 ELECTRIC POWER ENGINEERING

2001 Power Plants and Power Generation

Refer also to citation(s) 38354, 38732

38325 (CONF-8806363–) **Proceedings of the fouling and corrosion probe workshop, Chicago, Illinois.** Energetics, Inc., Columbia, MD (USA). 23 Jun 1988. 82p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC01-87CE40762. From Fouling and corrosion probe workshop; Chicago, IL, USA; 23 Jun 1988. Order Number DE89012686/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This report documents a fouling and corrosion probe workshop held on June 23, 1988 to review and discuss fouling and corrosion probe technologies and test plans. The workshop was sponsored by the US Department of Energy's Office of Industrial Programs and hosted by the Gas Research Institute. The report is comprised of the presentation hardcopies, comments made by workshop participants, final concluding remarks of the participants, and a revision of planned probe tests revised on the basis of the comments received at the workshop. It should be noted that the comments of the workshop participants are not necessarily "consensus" comments and, at time, have been paraphrased.

38326 (EPRI-CU–6279, pp. 10.1-10.2) **ASD converter issues.** Wood, P. (Westinghouse Electric Co., Pittsburgh, PA (USA)). Electric Power Research Inst., Palo Alto, CA (USA); TEM Associates, Inc., Emeryville, CA (USA); McCleer J. Power, Inc., Jackson, MI (USA). Mar 1989. (CONF-8711294–Summ.: Advanced adjustable speed drive R&D planning forum, Research Triangle Park, NC (USA), 30 Nov - 2 dec 1987). In *Proceedings: Advanced adjustable speed drive R and D planning forum.* Order Number DE89008783/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

A discussion of personal thoughts and opinions on the adjustable speed device (ASD) industry in this country is presented. On the power quality issue one hears a lot of talk but one doesn't see any real action. It's a known fact that switch converters create dirty power. In this regard switching converters can be classified by their size and ability to deal with power quality. Small converters can afford to clean up their input power through electronic sophistication. Very large converters are large enough to economically justify the use of passive input filters. The problem areas are the converters of intermediate size, too large to use fancy switching and too small to justify passive filtering. The principal points of ASD converters are discussed.

38327 (EPRI-CU–6279, pp. 11.1-11.18) **Control issues.** Bose, B.K. (Power Electric Applications Center, Knoxville, TN (USA)). Electric Power Research Inst., Palo Alto, CA (USA); TEM Associates, Inc., Emeryville, CA (USA); McCleer J. Power, Inc., Jackson, MI (USA). Mar 1989. (CONF-8711294–Summ.: Advanced adjustable speed drive R&D planning forum, Research Triangle Park, NC (USA), 30 Nov - 2 dec 1987). In *Proceedings: Advanced adjustable speed drive R and D planning forum.* Order Number DE89008783/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The control issues of adjustable speed drive (ASD) systems are discussed. The intent is to give a broad perspective in the area and make some future projections. A block diagram of a typical ASD system is presented. The control is the brain and the converter-machine system is the muscle. The control depends on the structure of the plant. Is it a DC machine of an AC machine? Several generic control issues can be identified in ASD systems. The first is that the control and signal processing architecture is determined by the control laws and output signals. The control laws are again based on plant structure and system specifications. Then, usually there is a PWM law in a drive system. Microcomputer/dedicated VLSI control implementation is now the universal trend. Computer-aided design and artificial intelligence in control are beginning a new era. This will create a tremendous impact on control of power electronic systems. Next there are the reliability and fault tolerance control issues; then diagnostics and dual function control on the utility line (i.e., a converter system in addition to functioning for ASD can also compensate line harmonics, VARs, unbalance or serve as a compensator for utility line transients). These issues are discussed.

38328 (EPRI-CU–6279, pp. 12.1-12.20) **Advances in motor control.** Lipo, T. (Univ. of Wisconsin, Madison (USA)). Electric Power Research Inst., Palo Alto, CA (USA); TEM Associates, Inc., Emeryville, CA (USA); McCleer J. Power, Inc., Jackson, MI (USA). Mar 1989. (CONF-8711294–Summ.: Advanced adjustable speed drive R&D planning forum, Research Triangle Park, NC (USA), 30 Nov - 2 dec 1987). In *Proceedings: Advanced adjustable speed drive R and D planning forum.* Order Number DE89008783/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

A common basis in all recent methods of AC motor control is vector or field oriented control. The desired orientation of the synchronously rotating reference frame for vector control is shown. The objective is to excite the stator windings of the machine such that only one component of the stator current, the direct axis component, is responsible for rotor flux generation (in an induction machine, in a synchronous machine this component is not needed) while the other stator current component, the quadrature axis component, is responsible for the machine torque. If the position of the rotor flux is known with respect to the synchronous reference frame the magnitudes and phases of the stator currents can be adjusted to achieve this optimum orientation. This decoupling of the stator currents enables the fastest and therefore the best control of the machine dynamics, since there is no inductive delay in the production of torque. The developed torque is in phase with the quadrature axis stator current. This torque production is shown in block diagram form.

38329 (EPRI-CU–6279, pp. 13.1-13.19) **New circuit topologies.** Divan, D. (Univ. of Wisconsin, Madison (USA)). Electric Power Research Inst., Palo Alto, CA (USA); TEM Associates, Inc., Emeryville, CA (USA); McCleer J. Power, Inc., Jackson, MI (USA). Mar 1989. (CONF-8711294–Summ.: Advanced adjustable speed drive R&D planning forum, Research Triangle Park, NC (USA), 30 Nov - 2 dec 1987). In *Proceedings: Advanced adjustable speed drive R and D planning forum.* Order Number DE89008783/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The drive for improved performance in power converters has traditionally been pursued with new and better devices. With the advent of devices like the GTO, BJT, power MOSFET, IGBT, etc., power converter performance has improved significantly. But high speed devices with Tr = 1 microsecond, Tf = 2 microseconds, and Ts = 10 microseconds are being used at switching frequencies of only 1.5 to 3 kHz, indicating suboptimal utilization. The fact is that most inverter designs are thermally limited, with 30% to 50% of the device losses being switching losses. The standard requirements for inverter designs are listed. Resonant converters have been designed to increase the useful switching frequency of power devices. These converters achieve energy transfer by resistive loading of an LC tank circuit. Control is maintained by frequency modulation of the resonant energy. But high Q operation requires that the power devices and the tank circuit itself have volt-amp ratings of about five to six times the rating of the converter output. Three resonant converter designs are described.

38330 (EPRI-CU–6279, pp. 14.1-14.16) **Harmonic and reactive compensation issues.** Smith, C. (McGraw-Edison Co., Canonsburg, PA (USA)). Electric Power Research Inst., Palo Alto, CA (USA); TEM Associates, Inc., Emeryville, CA (USA); McCleer J. Power, Inc., Jackson, MI (USA). Mar 1989. (CONF-8711294–Summ.: Advanced adjustable speed drive R&D planning forum, Research Triangle Park, NC (USA), 30 Nov - 2 dec 1987). In *Proceedings: Advanced adjustable speed drive R and D planning*

forum. Order Number DE89008783/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The increasing application of power electronics in residential, commercial, and industrial applications has led to a significant increase in the level of harmonic currents being injected into power systems. On the consumer side harmonics can contribute to improper operation of zero crossing detection circuitry or can represent nonpower production volt amperes which could lead to a power factor penalty. On the utility side harmonics can: disrupt the quality of service, produce damaging overvoltages due to harmonic resonances, produce damaging overcurrents which can increase losses and heating in transformers, machines and switchgear and lead to spurious fuse blowing, contribute to communication interference, impact the operation of conventional watthour meters and thermal demand meters, and impact the operation of protective relays. In concert with the trend toward widespread application of power factor correction capacitors, there has been a growing trend toward increased voltage distortion and potentially damaging resonance situations. The application of capacitors and tuned filters has also created a need for examination of potentially damaging transient and dynamic overvoltages during a variety of switching events. Reasons for reactive compensation are discussed.

38331 (EPRI-CU–6279, pp. 17.1-17.3) **PEAC's role in collaborative R&D and technology transfer.** Hilson, W. (Power Electronics Applications Center, Knoxville, TN (USA)). Electric Power Research Inst., Palo Alto, CA (USA); TEM Associates, Inc., Emeryville, CA (USA); McCleer J. Power, Inc., Jackson, MI (USA). Mar 1989. (CONF-8711294–Summ.: Advanced adjustable speed drive R&D planning forum, Research Triangle Park, NC (USA), 30 Nov - 2 dec 1987). In *Proceedings: Advanced adjustable speed drive R and D planning forum.* Order Number DE89008783/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The Power Electronics Application Center was formed to provide a national focus for power electronics and power electronics applications. Specifically, PEAC goals are to: establish and operate power electronics technology programs to improve electricity utilization; implement technology transfer and information dissemination activities; perform market and technology assessments; devise programs for research, development and application of power electronics devices, components, and systems; and to secure participatory support for PEAC programs form the manufacturer and user communities of power electronic systems. PEAC was formed on the basis that all of these goals can be accomplished through collaborative R&D and technology transfer. The role of PEAC in these activities is discussed.

38332 (EPRI-CU–6279, pp. 18.1-18.4) **Development and applications in low/moderate power drives.** Nondahl, T. (Allen-Bradley Co., Brown Deer, WI (USA)). Electric Power Research Inst., Palo Alto, CA (USA); TEM Associates, Inc., Emeryville, CA (USA); McCleer J. Power, Inc., Jackson, MI (USA). Mar 1989. (CONF-8711294–Summ.: Advanced adjustable speed drive R&D planning forum, Research Triangle Park, NC (USA), 30 Nov - 2 dec 1987). In *Proceedings: Advanced adjustable speed drive R and D planning forum.* Order Number DE89008783/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Motors for electromechanical energy conversion in the machine tool industry can, in general, be grouped by application: servo motors for workpiece motion and spindle motors for workpiece forming. The motor types that are in current use, DC wound field, DC PM, AC induction, and AC PM synchronous (or DC brushless, another name for the same thing) are described. Requirements for servo motors include, for cutting: high thrust and low speed, for transverse motion: low thrust and high speed, and for all applications: peak powers less than 2 HP and no need of external cooling. The current trends in machine tool servo motors and a chart showing the historical relationship between servo machines are given. The requirements for spindle motor drives are discussed. Current trends in spindle motors and a historical presentation of spindle drives are shown.

38333 (EPRI-CU–6279, pp. 19.1-19.4) **Development and applications in high power drives.** Ferrier, R. (Ross Hills Controls, Houston, TX (USA)). Electric Power Research Inst., Palo Alto, CA (USA); TEM Associates, Inc., Emeryville, CA (USA); McCleer J. Power, Inc., Jackson, MI (USA). Mar 1989. (CONF-8711294–Summ.: Advanced adjustable speed drive R&D planning forum, Research Triangle Park, NC (USA), 30 Nov - 2 dec 1987). In *Proceedings: Advanced adjustable speed drive R and D planning forum.* Order Number DE89008783/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The problems that must be dealt with in very large drives, i.e., 1000 HP and 2400 V and up are not the same as those in lower power drives. Over 60% of the business in this power range is retrofit of line drive machines with variable speed drives, with the prime selling point being economics. The principal technical requirement is a drive which produces a quasi-sine wave output so that existing machines can be used with no derating. All drives presently sold by Ross Hills Controls are current source inverters using standard SCRs. Large drives must have an efficiency of 98% or better. GTOs cannot give this level of performance. Large drives cost from $1500 to $5000 per kW. Today's technology for CSI drives with power factor correction on the drive output -motor terminals is quite adequate. MCTs would, however, eliminate the need to force commutate the DC link current at low motor speeds. There is a problem with motor neutral to ground voltage for larger drives (4160 V and above). Another technical problem that can be encountered in large drives is mechanical resonances excited by the drive/motor system which were not present when the machine was a fixed speed unit. A typical solution is simple stiffening at the trouble point. Solutions to these problems are presented.

38334 (EPRI-CU–6279, pp. 2.1-2.11) **Welcome, workshop format and objective.** Banerjee, B. Electric Power Research Inst., Palo Alto, CA (USA); TEM Associates, Inc., Emeryville, CA (USA); McCleer J. Power, Inc., Jackson, MI (USA). Mar 1989. (CONF-8711294–Summ.: Advanced adjustable speed drive R&D planning forum, Research Triangle Park, NC (USA), 30 Nov - 2 dec 1987). In *Proceedings: Advanced adjustable speed drive R and D planning forum.* Order Number DE89008783/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The purposes and objectives of the workshop are summarized. These are to: identify and discuss the major technical, marketing, application, and R&D issues for ASDs and their devices and components; identify and define the R&D needs for advanced ASDs, devices, components, and/applications; explore possible mechanisms by which these R&D needs could be met through collaborative or cooperative arrangements under the sponsorship and to the mutual benefit of ASD and component manufacturers and users; identify and develop a resource bank comprising engineering and scientific expertise, facilities, equipment, universities, manufacturers, national laboratories, and electric utilities to carry out R&D work; and establish a mechanism and schedule for continued discussions on common interests regarding the major technical issues and critical research needs for ASD devices, components and applications. The key issues to be discussed are marketing; products, equipment, and technology status; research and development needs; collaborative issues; and action plans. The ultimate objective of the workshop should be to establish a mutually agreeable program plan and schedule for ASD R&D work.

38335 (EPRI-CU–6279, pp. 20.1-20.18) **Utility applications of high power drives.** Oliver, J. (Bechtel Western Power Co., Norwalk, CA (USA)). Electric Power Research Inst., Palo Alto, CA (USA); TEM Associates, Inc., Emeryville, CA (USA); McCleer J. Power, Inc., Jackson, MI (USA). Mar 1989. (CONF-8711294–Summ.: Advanced adjustable speed drive R&D planning forum, Research Triangle Park, NC (USA), 30 Nov - 2 dec 1987). In *Proceedings: Advanced adjustable speed drive R and D planning forum.* Order Number DE89008783/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The power plant building boom in the United States started at the end of World War II and continued until about 1970. During that period all the utilities, privately owned and government owned, installed new generating units to match load growth requirements which averaged 7% a year compounded annually. These new generating units ranged in capacity from about 100 MW to 1300 MW each and used large draft fans and boiler feed pumps with horsepower ratings in the 1000 to 8000 HP range. Most of these units are still in service.

Many have reached the end of their design life and are candidates for life extension programs to gain another 30 to 40 years of useful power production. These motors are all squirrel cage induction motors and represent a market potential in the order of $250 million for conversion to adjustable speed as part of the life extension program. In 1981 EPRI contracted with Bechtel Power Corporation to conduct a major study on applying adjustable speed drives to existing power plant motors. Several such retrofit ASD configurations are shown. The significant aspects of the study are discussed.

38336 (EPRI-CU–6279, pp. 21.1-21.5) **Low power/high volume ASD applications.** Bhagwat, P. (Black & Decker, Baltimore, MD (USA)). Electric Power Research Inst., Palo Alto, CA (USA); TEM Associates, Inc., Emeryville, CA (USA); McCleer J. Power, Inc., Jackson, MI (USA). Mar 1989. (CONF-8711294–Summ.: Advanced adjustable speed drive R&D planning forum, Research Triangle Park, NC (USA), 30 Nov - 2 dec 1987). In *Proceedings: Advanced adjustable speed drive R and D planning forum.* Order Number DE89008783/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Very high volume application areas for electrical machines are in power tools, both portable and stationary, home appliances, and cordless/battery operated products. The major requirements for machinery in these industries are listed. The most important are low cost and ease of manufacture in high volumes. The types of adjustable speed drives that have been used or are presently being used in high volume applications are: AC phase control of a universal motor, SCR chopper control of a DC PM shunt motor, and gear/belt drive with induction motors. The entire industry would like to get away from commutators, but it's hard to beat the performance/price ratio of a universal motor. The advantages of commutatorless motors that the industry would like to be able to utilize (if the costs can be reduced) are shown. The major limitations due to the sources which power Black & Decker products are listed. Some of the limitations that force major requirements on motors, such as the ability to handle high stall currents, the ability to run continuously, and the ability to fail safe (i.e., overspeed protection) are discussed.

38337 (EPRI-CU–6279, pp. 22.1-22.14) **Limitations of present drive technology.** Plunkett, A. (AC Drive Technology, Portland, OR (USA)). Electric Power Research Inst., Palo Alto, CA (USA); TEM Associates, Inc., Emeryville, CA (USA); McCleer J. Power, Inc., Jackson, MI (USA). Mar 1989. (CONF-8711294–Summ.: Advanced adjustable speed drive R&D planning forum, Research Triangle Park, NC (USA), 30 Nov - 2 dec 1987). In *Proceedings: Advanced adjustable speed drive R and D planning forum.* Order Number DE89008783/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Present technology is either being used in commercially available equipment or is known about but not yet commercially available for a desired application. A typical, present technology variable voltage source AC industrial drive is shown. This type drive is used in a large number of motor load applications, some of which are described. Some more detail and typical output voltage and current waveforms for this voltage source drive are given. A present technology current source drive for an induction motor is shown. Typical line side waveforms for this current source drive are also given. Characteristic limitations of most present technology industrial drives, voltage source and current source, are described.

38338 (EPRI-CU–6279, pp. 25.1-25.3) **NEMA perspectives.** McCarthy, C. (National Electric Manufacturers Association, Washington, DC (USA)). Electric Power Research Inst., Palo Alto, CA (USA); TEM Associates, Inc., Emeryville, CA (USA); McCleer J. Power, Inc., Jackson, MI (USA). Mar 1989. (CONF-8711294–Summ.: Advanced adjustable speed drive R&D planning forum, Research Triangle Park, NC (USA), 30 Nov - 2 dec 1987). In *Proceedings: Advanced adjustable speed drive R and D planning forum.* Order Number DE89008783/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The National Electric Manufacturers Association is the largest organization of electrical equipment manufacturers in the US. Current membership is five hundred and ninety two companies. It has a yearly budget of approximately six million dollars, employs about one hundred people, and maintains nearly one thousand standards for the industry. There are seven major divisions within NEMA. Some current issues and interests at NEMA are: the differences between the IEC and NEMA systems for rating components, reciprocity between UL and CSA, general rules coordination between NEC and IEC, insulation coordination, allegiance to IEC or U.S. Standards, the relationship between technology accelerations and Standards, user driven technology, government affairs, competitiveness and anti-dumping legislation, and market measurement systems.

38339 (EPRI-CU–6279, pp. 26.1-26.4) **Power quality issues from the utility perspective.** Brown, D. (Baltimore Gas & Electric Co., MD (USA)). Electric Power Research Inst., Palo Alto, CA (USA); TEM Associates, Inc., Emeryville, CA (USA); McCleer J. Power, Inc., Jackson, MI (USA). Mar 1989. (CONF-8711294–Summ.: Advanced adjustable speed drive R&D planning forum, Research Triangle Park, NC (USA), 30 Nov - 2 dec 1987). In *Proceedings: Advanced adjustable speed drive R and D planning forum.* Order Number DE89008783/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Over the years, improving service reliability has been one of the primary goals of electric utility companies. They are constantly striving to reduce the number of service interruptions. Modern utilities are doing a better job of analyzing system faults and translating their findings into improved system designs and operating procedures. State-of-the-art electrical equipment and better utilization of available resources are two other tools being used to greatly enhance system reliability. Today, with the rapid proliferation of micro-electronics into virtually every appliance, the need to improve overall power quality has taken on a greater importance than merely improving reliability. Customers today can be adversely affected by power disturbances that they can't see, as well as by those they can see. Voltage spikes and transients can be more devastating to sensitive equipment than momentaries or sustained outages. Typical computer errors that are frequently blamed on power quality problems are shown. Spikes, transients, undervoltages, surges, momentaries, and sustained outages are all types of power disturbances that do and will continue to occur on any large utility distribution system. These same types of disturbances are also frequently generated within the customer's internal wiring system. Regardless of the cause of the source, customers are quick to blame utilities for all power disturbances because blinking lights and blackouts have always been associated with power problems on the utility system. At Baltimore Gas and Electric Company a Preomium Electric Service has been developed to improve the utility's ability to serve the customers' power quality needs. The operation of the Service is discussed.

38340 (EPRI-CU–6279, pp. 27.1-27.3) **Variable-speed heat pump testing program.** Ruohoniemi, T. (Honeywell, Inc., Golden Valley, MN (USA)). Electric Power Research Inst., Palo Alto, CA (USA); TEM Associates, Inc., Emeryville, CA (USA); McCleer J. Power, Inc., Jackson, MI (USA). Mar 1989. (CONF-8711294–Summ.: Advanced adjustable speed drive R&D planning forum, Research Triangle Park, NC (USA), 30 Nov - 2 dec 1987). In *Proceedings: Advanced adjustable speed drive R and D planning forum.* Order Number DE89008783/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

A program to characterize the losses in variable-speed heat pump systems is described. The objectives of this program are to: measure inverter, motor, and compressor efficiencies under controlled conditions, and investigate total system performance as well as individual component performance. Two heat pump systems were studied, both top-of-the-line units form Japanese manufacturers. Both used rolling-piston compressors and had wireless remote control units for adjusting the temperature setpoint and the indoor fan speed. One unit was driven with a 4-pole brushless DC motor and used the back emf voltages in the stator coils for rotor position sensing. The other unit was driven with a 2-pole induction motor with a voltage source interview with PWM logic contained in an ASIC. The objectives and results of the program are presented.

38341 (EPRI-CU–6279, pp. 28.1-28.2) **Power electronics marketing issues.** Ferraro, R. Electric Power Research Inst., Palo Alto, CA (USA); TEM Associates, Inc., Emeryville, CA (USA); McCleer J. Power, Inc., Jackson, MI (USA). Mar 1989. (CONF-8711294–Summ.: Advanced adjustable speed drive R&D planning forum, Research Triangle Park, NC (USA), 30 Nov - 2 dec 1987). In

Proceedings: Advanced adjustable speed drive R and D planning forum. Order Number DE89008783/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

From the EPRI/PEAC perspective it seems that there is plenty of technology in the power electronics world but there seems to be little movement in the power electronics marketplace. In the various power electronics markets there is a need to obtain, to know, or to understand: sources of market data, quality of market research, competitive issues, user groups and market segments, key players and influences, expanded data bases, and steps to new markets. The marketing of power electronics equipment is discussed.

38342 (EPRI-CU–6279, pp. 3.1-3.8) **New motor development.** Jahns, T. (General Electric, CRD, Schenectady, NY (USA)). Electric Power Research Inst., Palo Alto, CA (USA); TEM Associates, Inc., Emeryville, CA (USA); McCleer J. Power, Inc., Jackson, MI (USA). Mar 1989. (CONF-8711294–Summ.: Advanced adjustable speed drive R&D planning forum, Research Triangle Park, NC (USA), 30 Nov - 2 dec 1987). In *Proceedings: Advanced adjustable speed drive R and D planning forum.* Order Number DE89008783/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Recent motor developments for adjustable speed drive (ASD) applications worldwide have focused on brushless permanent magnet (PM) and switched reluctance (SR) machines. Insights can be gained into these motor developments by tracing the evolution of wound-field DC motors into PM field versions, magnets and armature windings. Wound-field salient-pole synchronous motors have similarly evolved into interior PM configurations. The SR motor is a very close relative of the more familiar variable-reluctance (VR) stepping motor, with the SR motor optimized for power conversion rather than high resolution stepping for motion control. The advantages of the surface mount PM machine include its simplicity, efficiency, and utilization of inverter switches. Its disadvantages in ASD applications include rotor position sensor requirements, high VSI switching losses due to low inductances, and magnet cost, brittleness, and temperature limitations A typical 3-phase surface PM motor VSI drive is discussed. The principal points discussed include: advanced motor developments increasing the competitiveness of brushless ASDs, PM and SR motors as alternatives to the induction motor for ASD applications, and motor characteristics must be matched to ASD application requirements.

38343 (EPRI-CU–6279, pp. 4.1-4.9) **New high power semiconductor devices.** Temple, V. (General Electric Co., Schenectady, NY (USA)). Electric Power Research Inst., Palo Alto, CA (USA); TEM Associates, Inc., Emeryville, CA (USA); McCleer J. Power, Inc., Jackson, MI (USA). Mar 1989. (CONF-8711294–Summ.: Advanced adjustable speed drive R&D planning forum, Research Triangle Park, NC (USA), 30 Nov - 2 dec 1987). In *Proceedings: Advanced adjustable speed drive R and D planning forum.* Order Number DE89008783/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Power devices can be roughly split into two categories: evolutionary devices, those devices which are improvements or evolve from older devices such as thyristors, BJTs and FETs; and revolutionary devices, new devices which offer new opportunities in circuit design, such as power integrated circuits, the insulated gate bipolar transistor (IGBT) and the MOS-controlled thyristor or MCT. Power devices limit power electronic systems in voltage and current, efficiency and weight/size, speed and ruggedness, operating temperature and cost. The power electronic circuit designer must consider; which power circuit/device to use, how to drive it, to what degree to integrate the gate drive and control subsystems, and which features are necessary and/or desirable. One large area for potential confusion is the acronym mystery game for the different power devices. Pity the poor new design engineer who has to wade through the different acronyms shown in Slide 4-1. Work on evolutionary devices such as the field controlled thyristor (which is the same as the SITh), the power photo-darlington transistor, the light triggered thyristor, an 8-10 kV power thyristor, a dot matrix GTO, and an advanced 5 kV GTO is discussed. IGBT and MCT devices are MOS gated devices and thus require very low gate control energy which can be supplied by single chip gate drive ICs. IC gate drives are developing rapidly. A summary of their benefits and capabilities is presented.

38344 (EPRI-CU–6279, pp. 5.1-5.27) **Low/moderate power semiconductor devices.** Baliga, J. (General Electric Co., Schenectady, NY (USA)). Electric Power Research Inst., Palo Alto, CA (USA); TEM Associates, Inc., Emeryville, CA (USA); McCleer J. Power, Inc., Jackson, MI (USA). Mar 1989. (CONF-8711294–Summ.: Advanced adjustable speed drive R&D planning forum, Research Triangle Park, NC (USA), 30 Nov - 2 dec 1987). In *Proceedings: Advanced adjustable speed drive R and D planning forum.* Order Number DE89008783/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Current trends in AC motor drives are shown. In short, the move is toward integration and smart control. An example of the evolution of a 5 HP drive is given. The key components that have been responsible for the reduction in the component count from over 1000 in the pre-1982 bipolar transistor based drive to less than 10 in the 1984 drive are the Insulated Gate Bipolar Transistor (IGBT) and the High Voltage Integrated Circuit (HVIC). The IGBT is a low cost three-terminal power switch which offers the advantages of a small chip size (low cost), high input impedance, and snubberless operation. The IGBT fulfills most, if not all, the requirements of the ideal power switch. The MCT is another new power device which can be used in low and medium power ASDs but it is not as advanced as the IGBT. Some of the current MCT application issues are listed and some recent measurements by Siemens which show the need for a snubber capacitor across the MCT are shown. Due to the reduced gate drive requirements of MOS controlled devices the entire gate drive and control circuitry can be integrated using HVIC technology. This integrated control technology can also offer protection against over-current, over-voltage, and over-temperature conditions.

38345 (EPRI-CU–6279, pp. 6.1-6.3) **Sensor technology.** Lorenz, R. (Univ. of Wisconsin, Madison (USA)). Electric Power Research Inst., Palo Alto, CA (USA); TEM Associates, Inc., Emeryville, CA (USA); McCleer J. Power, Inc., Jackson, MI (USA). Mar 1989. (CONF-8711294–Summ.: Advanced adjustable speed drive R&D planning forum, Research Triangle Park, NC (USA), 30 Nov - 2 dec 1987). In *Proceedings: Advanced adjustable speed drive R and D planning forum.* Order Number DE89008783/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

In adjustable speed drive (ASD) applications the sensed variables are position, velocity, acceleration, power, voltage, current, flux and torque. The manipulated variables are line or phase voltage (VSI drives) or current (CSI drives) and frequency. R&D opportunities exist in the areas of command driven accuracy, disturbance driven regulation, energy efficiency, and multiple drive systems. Specific opportunities in these areas are listed. R&D focus areas which will address these opportunities are also given.

38346 (EPRI-CU–6279, pp. 7.1-7.13) **Magnetic materials.** Kelley, A. (North Carolina State Univ., Raleigh (USA)). Electric Power Research Inst., Palo Alto, CA (USA); TEM Associates, Inc., Emeryville, CA (USA); McCleer J. Power, Inc., Jackson, MI (USA). Mar 1989. (CONF-8711294–Summ.: Advanced adjustable speed drive R&D planning forum, Research Triangle Park, NC (USA), 30 Nov - 2 dec 1987). In *Proceedings: Advanced adjustable speed drive R and D planning forum.* Order Number DE89008783/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The understanding of magnetic materials is critical to the proper design of power electronics circuits and rotating machines. Of all the elements in the periodic table, only iron, nickel, and cobalt exhibit ferromagnetism. All magnetic materials are formed by combining the ferromagnetic elements with other elements. These magnetic materials fall into two categories: soft and hard. Soft materials are used where easy magnetization and demagnetization is required such as in transformers and stators of machines. Hard materials are used where difficult demagnetization is required such as in permanent magnets used in machines. These magnetic materials fall into one or more of the three following classes: metallic crystalline, ferrite, and metallic amorphous. Soft metallic crystalline alloys are a relatively mature technology to which various refinements are being made. Soft ferrites, while a newer technology, is also relatively mature and further refinements are being made especially with respect to high frequency materials and core shapes. Soft metallic amorphous materials (glassy metals) are relatively new

and are undergoing continued efforts aimed at improving their properties. The major drawback of the amorphous materials is their hardness and brittleness. Hard magnetic materials have undergone an evolution from alnico to ferrite to samarium cobalt to neodymium iron boron. In each instance the material properties were improved, but each material has a drawback that keeps it from being the ideal permanent magnet material. Power electronics applications have revived interest in magnetic materials intended for high-power high-frequency use. There is an industry-wide need for better techniques to reduce material and fabrication costs and for more uniform formats for reporting material characteristics. These properties of these materials are discussed.

38347 (EPRI-GS–6427) **Hydraulic transients in cooling-water systems: Final report.** Martin, C.S.; Wiggert, D.C. Electric Power Research Inst., Palo Alto, CA (USA); Georgia Inst. of Tech., Atlanta, GA (USA). School of Civil Engineering. c Jun 1989. 147p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50409, Palo Alto, CA 94303.

This report constitutes a comprehensive investigation of hydraulic transients in cooling water systems of power stations, with emphasis on once-through configurations. The three major thrusts of the program were (1) a critical survey of experience with transients in CW systems worldwide; (2) collection and analysis of field data from the Shoreham Nuclear Station CW system, and (3) the development and testing of numerical algorithms for analysis. As a result of the experience at many power stations and the difficulty in analytically modelling hydraulic transients because of the uncertainty regarding the amount of free air present in a CW system, design and test methodologies are outlined. A careful survey of field experiences from a number of operating CW systems throughout the world indicates that severe pressure surges occur infrequently as a result of pump power failure. In fact, experience has shown that vacuum breakers are not necessary for all once-through systems. Field results often yield, maximum pressures that are far less than those predicted from waterhammer codes that do not allow for the presence of free air from any source. Indeed, on-site measurements at Shoreham yielded peak pressures always less than initial steady ones for the case of pump power failure. The difference between calculation and observation is attributed to free air, the amount of which is very difficult to predict. Two numerical codes were developed to simulate the presence of free air in a CW system in distributed or lumped modes. Both codes, a modified method of characteristics and a four-point implicit technique, produce similar results, and are viewed as well developed and adequate. 68 refs., 35 figs., 6 tabs.

38348 (PNL–6548) **Cost analysis of power plant cooling using aquifer thermal energy storage.** Zimmerman, P.W.; Drost, M.K. Pacific Northwest Lab., Richland, WA (USA). May 1989. 48p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC06-76RL01830. Order Number DE89014381/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Most utilities in the US experience their peak demand for electric power during periods with high ambient temperature. Unfortunately, the performance of many power plants decreases with high ambient temperature. The use of aquifer thermal energy storage (ATES) for seasonal storage of chill can be an alternative method for heat rejection. Cold water produced during the previous winter is stored in the aquifer and can be used to provide augmented cooling during peak demand periods increasing the output of many Rankine cycle power plants. This report documents an investigation of the technical and economic feasibility of using aquifer thermal energy storage for peak cooling of power plants. 9 refs., 15 figs., 5 tabs.

38349 (SFB–256-49(prepr.)) **On shape optimization of a turbine blade.** Alt, H.W. Bonn Univ. (Germany, F.R.). Sonderforschungsbereich 256 - Nichtlineare Partielle Differentialgleichungen. Oct 1988. 32p. Available from Copy held by UB/TIB Hannover.

An optimization problem for turbine blades with given velocity distribution on the blade surface is formulated as a minimum problem with free boundary. The existence of a solution and some regularity properties are proved. (orig.).

2002 Environmental Control Technology

Refer also to citation(s) 37919, 37920

2003 Power Transmission and Distribution

Refer also to citation(s) 38956, 38958

38350 (PNL-SA–15585) **Load management alternatives to transmission and distribution construction.** Englin, J.E.; DeSteese, J.G. Pacific Northwest Lab., Richland, WA (USA). Aug 1988. 12p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC06-76RL01830. (CONF-8809142–3: American Council for an Energy Efficient Economy conference, Pacific Grove, CA, USA, 3 Sep 1988). Order Number DE89014932/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper presents results of the Conservation-in-Lieu-of-Construction (CILOC) Study undertaken by Pacific Northwest Laboratory for Bonneville Power Administration. The objective was to assess the potential for end-use load management to defer the need for new transmission and distribution (T and D) construction in areas experiencing load growth. Software was developed for this purpose and applied to the Toledo-Wren area of Oregon, as a test case. The CILOC potential of residential water heater controls, ceramic space heaters and the combined effect of both options was evaluated. The combined effect of both measures was shown to be a lower cost alternative to new T and D construction for up to 9 years. Individually, the options were effective between 4 and 8 years, depending on the industrial growth scenario considered. The results indicate clearly that, in cases where there is isolated load growth, load management can be a viable alternative to T and D construction. 6 refs., 7 figs.

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Refer also to citation(s) 37961

38351 (NUREG–0020-Vol.13-No.6) **Licensed operating reactors: Status summary report data as of 05-31-89.** Nuclear Regulatory Commission, Washington, DC (USA). Office of Information Resources Management. Jun 1989. 540p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A23/MF A01 - GPO - OSTI.

The US Nuclear Regulatory Commission's monthly LICENSED OPERATING REACTORS Status Summary Report provides data on the operation of nuclear units as timely and accurately as possible. This information is collected by the Office of Information Resources Management, from the Headquarters Staff of NRC's Office of Inspection and Enforcement, from NRC's Regional Offices, and from utilities. Since all of the data concerning operation of the units are provided by the utility operators less than two weeks after the end of the month, necessary corrections to published information are shown on the ERRATA page. This report is divided into three sections: the first contains monthly highlights and statistics for commercial operating units, and errata from previously reported data; the second is a compilation of detailed information on each unit, provided by NRC Regional Offices, IE Headquarters and the Utilities; and the third section is an appendix for miscellaneous information such as spent fuel storage capability, reactor years of experience and non-power reactors in the United States.

38352 (NUREG–1272-Vol.3-No.1) **AEOD (Office for Analysis and Evaluation of Operational Data): 1988 annual report, Power reactors.** Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data. Jun 1989. 220p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A10/MF A01 - GPO - OSTI.

The annual report of the US Nuclear Regulatory Commission's Office for Analysis and Evaluation of Operational Data (AEOD) is devoted to the activities performed during 1988. The report is published in two separate parts. The report is published in two separate parts. NUREG-1272, Vol. 3, No. 1, covers Power Reactors and presents an overview of the operating experience of the nuclear power industry, including comments about the trends of some key

performance measures. The report also includes the principal findings and issues identified in AEOD studies over the past year and summarizes information from Licensee Event Reports, Diagnostic Evaluations, and reports to the NRC's Operations Center. NUREG-1272, Vol. 3, No. 2, covers Nonreactors and presents a review of the nonreactor events and misadministrations that were reported in 1988 and a brief synopsis of AEOD studies published in 1988. Each volume contains a list of the AEOD reports issued for 1980–1988. 15 figs., 10 tabs.

38353 (ORNL/FTR–3310) **Report on the meetings of the small and medium size reactor (SMR) expert group of the organization for economic cooperation and development (OECD), Paris, France, June 15-16, 1989: Foreign trip report.** Rowan, W.J. Oak Ridge National Lab., TN (USA). 5 Jul 1989. 23p. Sponsored by DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89014871/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler attended the meeting of the Small and Medium Size Reactor (SMR) Expert Group of the OECD. The group agreed to identify the potential for SMRs in OECD countries and to document their views in a report. The group also developed and initiated a plan and schedule for this effort. This report describes significant activities that took place during the meeting and presents relevant information that has been collected in recent international studies.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

Refer also to citation(s) 38384, 38405, 38407, 38417, 38422, 38429, 38430, 38431, 38441, 38442, 38443, 38445, 38448, 38449, 38462, 38928, 38929

38354 (CONF-890852–1) **Low-flow operation and testing of pumps in nuclear plants.** Greenstreet, W.L. Oak Ridge National Lab., TN (USA). 1989. 23p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. 1886-8082-8B. From ASME/NRC symposium on inservice testing of pumps and valves; Washington, DC, USA; 1-3 Aug 1989. Order Number DE89007838/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Low-flow operation of centrifugal pumps introduces hydraulic instability and other factors that can cause damage to these machines. The resulting degradation has been studied and recorded for pumps in electric power plants. The objectives of this paper are to (1) describe the damage-producing phenomena, including their sources and consequences; (2) relate these observations to expectations for damage caused by low-flow operation of pumps in nuclear power plants; and (3) assess the utility of low-flow testing. Hydraulic behavior during low-flow operation is reviewed for a typical centrifugal pump stage, and the damage-producing mechanisms are described. Pump monitoring practices, in conjunction with pump performance characteristics, are considered; experience data are reviewed; and the effectiveness of low-flow surveillance monitoring is examined. Degradation caused by low-flow operation is shown to be an important factor, and low-flow surveillance testing is shown to be inadequate. 18 refs., 5 figs., 4 tabs.

38355 (DOE/NE/34122–T1) **The Studsvik Super-Ramp Extension Project: Final report.** Djurle, S. Studsvik Energiteknik AB, Nykoeping (Sweden). Nov 1986. 213p. Sponsored by DOE Nuclear Energy. DOE Contract FG01-84NE34122. (STUDSVIK-STSRX–18). Order Number DE89012643/JAW. Available from NTIS (US Sales Only), PC A10/MF A01 - OSTI; GPO Dep.

The Studsvik Super-Ramp Extension (SRX) project is one in a series of internationally sponsored projects performed by Studsvik for the study of pellet clad interaction (PCI) failure propensity of typical light water reactor (LWR) test fuel rods. The SRX project is a continuation of the Super-Ramp (SR) project whose principal purpose was to investigate the failure propensity of test fuel rods when subjected to power ramping, after base irradiation to high burnup. The prime incentive to perform such studies of high burnup rods and related problems is the economic benefit of extending the discharge burnup level of LWR fuel. This document describes the projects and its results. 50 refs., 91 figs., 24 tabs.

38356 (EGG-M–88205) **Aging degradation of BWR [Boiling Water Reactor] reactor internals.** Ware, A.G. EG and G Idaho, Inc., Idaho Falls, ID (USA). 1989. 6p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC07-76ID01570. (CONF-890855–28: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA, USA, 14-18 Aug 1989). Order Number DE89010982/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Researchers at the Idaho National Engineering Laboratory recently performed an assessment of the aging of the reactor internals in Boiling Water Reactors (BWRs), and identified the unresolved technical issues related to the degradation of these components. Several failures in BWR reactor internals have been caused by a combination of susceptible materials, environment, preload stress, and flow-induced vibration. ASME Code Section XI inservice inspection requirements are insufficient for detecting aging-related degradation in reactor internals. Many of the susceptible locations are not accessible for inspection. 9 refs., 1 fig., 2 tabs.

38357 (EGG-M–88527) **Full scale valve qualification and flow interruption testing provides insights on industry motor operator sizing shortcomings and diagnostic testing limitations.** Steele, R. Jr.; DeWall, K.G. EG and G Idaho, Inc., Idaho Falls, ID (USA). 1989. 30p. Sponsored by DOE Nuclear Energy. DOE Contract AC07-76ID01570. (CONF-890852–2: ASME/NRC symposium on inservice testing of pumps and valves, Washington, DC, USA, 1-3 Aug 1989). Order Number DE89011110/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper presents the results of full-scale high-energy qualification and flow interruption gate valve testing sponsored by the United States Nuclear Regulatory Commission (USNRC) and conducted by researchers from the Idaho National Engineering Laboratory (INEL). We modified two representative 6-in., 900-lb valve assemblies to include a high-temperature load cell in the valve stems to directly measure stem thrust. Instrumentation in the flow loop and in the motor operators measured all important responses. At various times during the test program, all of the currently popular diagnostic test systems also monitored the performance of the valve motor operators. The valves were subjected to hydraulic and leakage testing (ANSI B16.41, QV4) and to flow interruption (valve closure) testing at boiling water reactor (BWR) temperature and pressure line break conditions. The tests included reopening the valves at high flow. Test results show that current industry motor operator sizing equations are not conservative, that thrusts required to close valves are sensitive to the fluid temperature, and that the results of testing at lower pressures and flows can not be extrapolated to design basis flows, temperatures, and pressures. 13 figs.

38358 (EPRI-NP–6424-M) **Control of nitrogen-16 in BWR [boiling water reactor] main steam lines under hydrogen water chemistry conditions: Final report.** Ruiz, C.P.; Lin, C.C.; Wong, T.L. Electric Power Research Inst., Palo Alto, CA (USA); General Electric Co., San Jose, CA (USA). Nuclear Energy Div. c Jul 1989. 17p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The primary aim of this work was to attempt to identify methods to limit or control the N-16 main steam increases which occur as a result of plant operation under hydrogen water chemistry. The hydrogen water chemistry test data for 8 plants, N-13 chemistry measurements performed at three plants and N-16 main steam concentration measurements made at five plants were analyzed and correlations established. As a result of this study, potential chemical and physical control methods were identified. The test data compilations for the eight plants are included in this report. 6 figs.

38359 (NUREG–1360) **Technical specifications: Limerick Generating Station, Unit No. 2 (Docket No. 50-353): Appendix "A" to license No. NPF-83.** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. Jun 1989. 533p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A23/MF A01 - GPO - OSTI.

The Limerick, Unit 2, Technical Specifications were prepared by the US Nuclear Regulatory Commission to set the limits, operating conditions, and other requirements applicable to a nuclear reactor facility as set forth in Section 50.36 of 10 CFR Part 50 for the protection of the health and safety of the public.

38360 (ORNL/tr–89/30) **Boiling water reactor.** Yamamoto, Toru. Oak Ridge National Lab., TN (USA). 31 Oct 1987. 17p. Translated from, Kokai Tokkyo Koho, Patent office of Japan (1987), pp. 507-513. Sponsored by DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89014854/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This document describes a boiling water reactor characterized by two types of fuel assemblies, both of which include some fuel rods containing nuclear fuel and others containing a burnable poison: Type 1 fuel assemblies have more fuel rods containing a burnable poison than Type 2 fuel assemblies, but the concentration of the burnable poison in the above fuel rods in Type 1 fuel assemblies is lower than that in the fuel rods containing a poison in Type 2 fuel assemblies. The amount of burnable poison in the fuel rods containing the poison placed in Type 1 fuel assemblies as mentioned above is determined for the shortest operational duration of the reactor. The amount of burnable poison in the fuel rods containing the poison placed in the Type 2 fuel assembly is determined for the longest operational duration of the reactor. Excess reactivity variations due to fuel burnup can be reduced even when the period of operation varies. Hence, it is easier to assure a reactor shutdown tolerance, making it possible to provide a safer nuclear reactor. Since it is also possible to reduce the number of control rod pattern adjustments for the purpose of controlling reactivity during a cycle, improved rated operation of a nuclear plant can be obtained. Furthermore, low excess reactivity can reduce the number of control rods being inserted into the core during operation, which in turn can reduce the number of replacements of control rods due to a deterioration in the control capacity of the control rods. 14 figs.

38361 Probability of crack-induced failure in BWR recirculation piping. Holman, G.S. (Lawrence Livermore National Lab., CA (USA)). *Nuclear Engineering and Design (Netherlands),* 113(3): 369-383 (May 1989). (CONF-870812–: 9. biennial international conference on structural mechanics in reactor technology (SMIRT-9), Lausanne (Switzerland), 17-21 Aug 1987).

The Lawrence Livermore National Laboratory (LLNL) has estimated the probability of double-ended guillotine break (DEGB) in the reactor coolant piping of Mark I BWR plants. Two causes of pipe break are considered: crack growth at welded joints and the seismically-induced failure of component supports. For the former a probabilistic fracture mechanics model is used, for the latter a probabilistic support reliability model. This paper describes a probabilistic model developed to account for effects of intergranular stress corrosion cracking (IGSCC). The IGSCC model, based on experimental and field data compiled from several sources, correlates times to crack initiation and crack growth rates for Types 304 and 316NG stainless steel against material-specific "damage parameters" which consilidate the separate effects of coolant environment (temperature, dissolved oxygen content, level of impurities), stress (including residual stress), and degree of sensitization. Application of this model to actual BWR recirculation piping shows that IGSCC clearly dominates the probability of failure in 304SS piping, mainly due to cracks that initiate within a few years after plant operation has begun. Replacing Type 304 piping with 316NG reduces failure probabilities by several orders of magnitude. (orig.).

38362 Nuclear reactor spacer grid and ductless core component. Christiansen, D.W.; Karnesky, R.A. To Dept. of Energy, Washington, DC. USA Patent 4,818,479. 4 Apr 1989. Filed date 4 Oct 1985. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

This invention relates to a nuclear reactor spacer grid member for use in a liquid cooled nuclear reactor and to a ductless core component employing a plurality of these spacer grid members. The spacer grid member is of the egg-shell type and is constructed so that the walls of the cell members of the grid member are formed of a single thickness of metal to avoid tolerance problems. Within each cell member is a hydraulic spring which laterally constrains the nuclear material bearing rod which passes through each cell member against a hardstop in response to coolant flow through the cell member. This hydraulic spring is also suitable for use in a water cooled nuclear reactor. A core component constructed of, among other components, a plurality of these spacer grid members, avoids the use of a full length duct by providing spacer sleeves about the sodium tubes passing through the spacer grid members at locations between the grid members, thereby maintaining a predetermined space between adjacent grid members.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

Refer also to citation(s) 38354, 38355, 38362, 38384, 38401, 38405, 38407, 38417, 38427, 38431, 38441, 38442, 38443, 38444, 38448, 38449, 38450, 38453, 38455, 38461, 38462, 38928, 38929, 39155, 39515

38363 (CONF-890855–19) **Radiation embrittlement of PWR vessel supports.** Cheverton, R.D.; Robinson, G.C.; Pennell, W.E.; Nanstad, R.K. Oak Ridge National Lab., TN (USA). 1989. 13p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. From 10. international conference on Structural Mechanics in Reactor Technology (SMIRT); Anaheim, CA, USA; 14-18 Aug 1989. Order Number DE89010259/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Several studies pertaining to radiation damage of PWR vessel supports were conducted between 1978 and 1987. During this period, apparently there was no reason to believe that low-temperature (<100°C) MTR embrittlement data were not appropriate for evaluating embrittlement of PWR vessel supports. However, late in 1986, data from the High Flux Isotope Reactor (HFIR) vessel surveillance program indicated that the embrittlement rates of the several HFIR vessel materials (A212-B, A350-LF3, A105-II) were substantially greater than anticipated on the basis of MTR data. Further evaluation of the HFIR data suggested that a fluence-rate effect was responsible for the apparent discrepancy, and shortly thereafter it became apparent that this rate effect was applicable to the evaluation of LWR vessel supports. As a result, the Nuclear Regulatory Commission (NRC) requested that the Oak Ridge National Laboratory (ORNL) evaluate the impact of the apparent embrittlement rate effect on the integrity of light-water-reactor (LWR) vessel supports. The purpose of the study was to provide an indication of whether the integrity of reactor vessel supports is likely to be challenged by radiation-induced embrittlement. The scope of the evaluation included correlation of the HFIR data for application to the evaluation of LWR vessel supports; a survey and cursory evaluation of all US LWR vessel support designs, selection of two plants for specific-plant evaluation, and a specific-plant evaluation of both plants to determine critical flaw sizes for their vessel supports. 19 refs., 8 figs., 2 tabs.

38364 (EGG-M–88422) **Remedies for PWR [pressurized water reactor] recirculating steam generator tube aging.** Amar, A.S.; Shah, V.N. EG and G Idaho, Inc., Idaho Falls, ID (USA). 1989. 7p. Sponsored by DOE Nuclear Energy. DOE Contract AC07-76ID01570. (CONF-890855–27: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA, USA, 14-18 Aug 1989). Order Number DE89011113/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Pressurized water reactor (PWR) steam generator tubes form well over one-half of the primary system pressure boundary and have experienced significant aging degradation at some plants. Tube failures have caused contamination of the secondary coolant by the primary coolant, and radiological releases to the environment when atmospheric relief valves were actuated. Degraded steam generator tubes may fail during a severe accident and allow radioactive material to bypass containment. Simultaneous rupture of several tubes may lead to a major plant temperature and pressure transient with potential impact on the structural integrity of various components in the system. Tube leakages result in unscheduled plant outages when the leakage rate exceeds acceptable limits. Finally, repair and replacement associated with steam generators account for much of the personnel radiation exposure (manrems) at PWR plants. Therefore, industry has developed various remedies for steam generator tube aging. This paper evaluates the effectiveness of current remedies used to reduce aging damage to recirculating type steam generator tubes (Shah and MacDonald, 1988). The following topics are discussed: degradation mechanisms, mitigation techniques, repair methods, and conclusions and recommendations. 11 refs., 2 tabs.

38365 (EGG-M–89093) **Research needs for fatigue damage assessment in PWR surge and spray piping.** Shah, V.N.; Conley, D.A. EG and G Idaho, Inc., Idaho Falls, ID (USA). 1989. 7p. Sponsored by DOE Nuclear Energy. DOE Contract AC07-76ID01570. (CONF-890855–26: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA, USA, 14-18 Aug 1989). Order Number DE89011112/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

PWR surge and spray pipings have experienced significant low- and high-cycle fatigue damage during normal operation. The damage has resulted in plastic deformations and large elastic deflections of the horizontal piping. This damage has been observed in both domestic and foreign plants. Much of this damage is caused by stratified flows and thermal striping, which were not accounted for in the original design. This paper identifies the research necessary (1) for revising regulatory requirements so that fatigue damage can be realistically assessed, (2) for developing and modifying ASME Codes and Standards so that fatigue damage can be detected and monitored, and (3) for revising design practices and operating procedures so that the fatigue damage can be reduced. Topics are discussed as follows: (1) operating conditions leading to stratified flows and thermal striping, (2) high- and low-cycle fatigue damage, (3) estimation and detection of fatigue damage, and (4) conclusions and recommendations.

38366 (INIS-mf–11481) **Nuclear power day. Abstracts of papers.** Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia). 10 Nov 1988. 11p. (In Czech). (CONF-8810395–: Nuclear power day, Rez, Czechoslovakia, 26 Oct 1988). Order Number DE89631477/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Excerpts are presented of six papers presented at the one-day seminar held in October 1988 at the Institute of Nuclear Research in Rez near Prague, Czechoslovakia. The first three papers were devoted to the role of nuclear power in the development of rational power husbandry in Czechoslovakia, the cooperation of the COMECON countries in nuclear power and the incorporation of nuclear power in the Complex Program, of Scientific and Technical Advance of the COMECON countries to the year 2000. The second two papers deals with ways of improving the technical and economic parameters of WWER reactors and with the problems of extending the life of nuclear power plants. The sixth paper deals with the possibility of using high temperature reactors in Czechoslovakia. (Z.M.).

38367 (NUREG/CR–5349) **Steam generator operating experience, update for 1987–1988.** Frank, L.; Stokley, J. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering and Systems Technology; Science Applications International Corp., McLean, VA (USA). Jun 1989. 100p. Sponsored by Nuclear Regulatory Commission. (SAIC–89/1113). Available from NTIS, PC A06/MF A01 - GPO - OSTI.

This report summarizes operational events and degradation mechanisms affecting pressurized water reactor steam generator integrity, provides results of 1987 and 1988 steam generator inspections, and highlights both prevalent problem areas and improvements that have been made in nondestructive testing methods, preventive measures, repair techniques, and replacement procedures. It describes the equipment of the three major suppliers and discusses recent examinations of 76 plants. Major areas of concern are the steam generator degradation mechanisms that affect tube integrity or cause tube leakage and tube failure. These include intergranular attack (IGA), intergranular stress corrosion cracking (IGSCC), primary water stress corrosion cracking (PWSCC), pitting, and vibrational wear and fatigue. Also discussed are plugging, sleeving, heat treatment, peening, chemical cleaning, and steam generator replacements, the current status of regulatory instruments and inspection guidelines for ensuring the steam generator integrity, and highlights of steam generator research and unresolved safety issues. The report concludes that cracking, both IGSCC on the tube outside diameter and PWSCC on the tube inside diameter, was the major cause of tube degradation during the 1987–1988 period. 24 refs., 8 tabs.

38368 (OEFZS–4495) **Generation of a MARCH 3-Input Data Set for a WWER-1000 type reactor as a base of a source term study using the 'Source Term Code Package'.** Nathschlaeger, P. Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (Austria). Feb 1989. 16p. (In German). (EA–331/89). Order Number DE89631478/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

To perform a source term study for a WWER-1000 type reactor the input data set for the first ZION-sample problem of the Source Term Code Package (STCP) is described at first. Then available WWER-1000 literature is scanned to make the first step of changing the ZION-data set into a WWER-1000 data set for use in MARCH 3 (the first modul of STCP). These input data are discussed in detail. 6 refs.

38369 (SAND–88-3347C) **Irradiation embrittlement investigation of the Shippingport Station neutron shield tank.** Rosinski, S.T.; Shack, W.J.; Chopra, O.K. Sandia National Labs., Albuquerque, NM (USA). 1989. 11p. Sponsored by DOE/NE;NRC. DOE Contract AC04-76DP00789. (CONF-890820–1: 4. international symposium on environmental degradation of materials in nuclear power systems: water reactors, Jekyll Island, GA (USA), 6-10 Aug 1989). Order Number DE89013156/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A joint effort between the US Nuclear Regulatory Commission and the US Department of Energy is under way to investigate the low- temperature, low-fluence rate embrittlement of reactor vessel support structures through analysis of the decommissioned Shippingport Station neutron shield tank (NST). The Shippingport NST operated at a temperature of 130°F (55°C) and saw a maximum fluence of approximately 6×10^{17} n/cm^2, $E > 1$ MeV. To characterize the embrittlement behavior of the NST material, eleven 6-inch diameter discs were removed from the irradiated inner shell of the NST along with the corresponding material from the slightly irradiated outer shell. Standard Charpy V-notch tests on the most highly irradiated NST material indicate a shift in the transition temperature (measured at 15 ft-lbs) of approximately 45°F (25°C) after 9.25 effective full power years of operation. This shift is not as severe as that expected based on surveillance results at the High Flux Isotope Reactor. The resultant transition temperature, however, is close to the NST service temperature. A low toughness at service temperature is also indicated. 10 refs., 8 figs., 1 tab.

38370 (UFRJ-COPPE-PTC–01/82) **Problems of Angra-1 reactor start-up.** Rosa, L.P. Universidade Federal, Rio de Janeiro, RJ (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia. 1982. 24p. (In Portuguese). Order Number DE89631479/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The main operation problems of Angra 1 reactor, evaluating the energy production within the Brazilian energy framework are analysed. (M.C.K.).

2103 Power Reactors, Non-breeding, Graphite Moderated

Refer also to citation(s) 38400, 38432, 38434, 38438, 38454, 38766, 39130, 39136, 39142, 39153, 39154, 39169

38371 (JAERI-M–89-005) **High-temperature structural design code for the High Temperature Engineering Test Reactor.** Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1989. 55p. (In Japanese). Order Number DE89790942/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

This code provides guidelines and procedures which apply to structural designing of the class I components of the HTTR. The code is established from efforts under R and D programs of HTGR in Japan, referring to the Elevated-Temperature Structural Design Guide for Class I Components of Prototype Fast Breeder Reactor 'Monju'. The following structural features are incorporated in establishing the code. (1) The structural materials are Hastelloy XR, 2-1/4Cr-1Mo steel and austenitic stainless steels. (2) Loading conditions, e.g., heat transfer tubes of the Intermediate Heat Exchanger are designed on small differential pressure between the primary and secondary coolants in normal operating condition. (3) HTTR-helium environment effect. (4) Irradiation effect on 2-1/4Cr-1Mo steel (used as the reactor pressure vessel).

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

Refer also to citation(s) 38411

38372 (INIS-mf–11440, pp. 622-623) **Dose rate evaluation for the shield cooling system at a CANDU nuclear power plant.** Mateescu, S. (Institutul de reactori nucleari energetici, Bucharest, Romania); Stanciu, M. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics*. Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The specific activity per isotope in the cooling light water, for the main three components of the system- pumps, heat exchangers and ion exchanger, for nine isotopes has been calculated. (authors).

2105 Power Reactors, Breeding

Refer also to citation(s) 38409, 38421, 38435

38373 (CONF-890673–3) **Automated start-up of EBR-II: A preview.** Kisner, R.A. Oak Ridge National Lab., TN (USA). 1989. 20p. Sponsored by DOE Nuclear Energy. DOE Contract AC05-84OR21400. From IWGFR specialists meeting on advanced controls for fast reactors; Argonne, IL (USA); 20-22 Jun 1989. Order Number DE89015042/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Oak Ridge National Laboratory (ORNL) and Argonne National Laboratory (ANL) are undertaking a joint project to develop control philosophies, strategies, and algorithms for computer control of the start-up mode of the Experimental Breeder Reactor II (EBR-II). The major objective of this project is to show that advanced liquid-metal reactor (LMR) plants can be operated from low power to full power using computer control. Development of an automated control system with this objective in view will help resolve specific issues and provide proof through demonstration that automatic control for plant start-up is feasible. This paper describes the approach that will be used to develop such a system and some of the features it is expected to have. Structured, rule-based methods, which will provide start-up capability from a variety of initial plant conditions and degrees of equipment operability, will be used for accomplishing mode changes during plant start-up. Several innovative features will be incorporated such as signal, command, and strategy validation to maximize reliability, flexibility to accommodate a wide range of plant conditions, and overall utility. Continuous control design will utilize figures of merit to evaluate how well the controller meets the mission requirements. The operator interface will have unique "look ahead" features to let the operator see what will happen next. 15 refs., 7 figs., 1 tab.

38374 (CONF-890819–17) **Analysis of unprotected overcooling events in the Integral Fast Reactor.** Vilim, R.B. Argonne National Lab., IL (USA). 1989. 15p. Sponsored by DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From ASME/AIChE national heat transfer conference; Philadelphia, PA (USA); 6-9 Aug 1989. Order Number DE89013283/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Simple analytic models are developed for predicting the response of a metal fueled, liquid-metal cooled reactor to unprotected overcooling events in the balance of plant. All overcooling initiators are shown to fall into two categories. The first category contains these events for which there is no final equilibrium state of constant overcooling, as in the case for a large steam leak. These events are analyzed using a non-flow control mass approach. The second category contains those events which will eventually equilibrate, such as a loss of feedwater heaters. A steady flow control volume analysis shows that these latter events ultimately affect the plant through the feedwater inlet to the steam generator. The models developed for analyzing these two categories provide upper bounds for the reactor's passive response to overcooling accident initiators. Calculation of these bounds for a prototypic plant indicate that failure limits – eutectic melting, sodium boiling, fuel pin failure – are not exceeded in any overcooling event. 2 refs.

38375 (HEDL-SA–3335) **The examination and replacement of electromagnetic pump from FFTF primary circuit.** Brehm, W.F.; Grygiel, M.L.; Lutton, J.M.; McCargar, C.G.; Young, M.W. Westinghouse Hanford Co., Richland, WA (USA). Nov 1985. 51p. Sponsored by DOE Nuclear Energy. DOE Contract AC06-76FF02170. (CONF-851115–56: American Nuclear Society winter meeting, San Francisco, CA (USA), 10-15 Nov 1985). Order Number DE89014951/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

On November 16, 1984 a leak was discovered in the Fast Flux Test Facility (FFTF) Primary Sodium Sampling System electromagnetic pump. The leak was discovered in the course of routine cell entry to investigate the shorted trace heat element. The purpose of this paper is to describe the circumstances surrounding the occurrence of the leak, the processes involved in producing the leak and efforts taken to minimize their effects on future operation of electromagnetic pumps at FFTF. In addition, the replacement of the pump and recovery of the plant also are described. The relative ease of recovery from this incident is indicative of the overall feasibility of the LMR concept.

38376 (HEDL-SA–3599) **Selection of a handling and maintenance option for the SP-100 ground engineering system test.** Shen, E.J.; Schweiger, L.J.; Miller, W.C.; Gluck, R.; Davies, S.M. Westinghouse Hanford Co., Richland, WA (USA). Apr 1987. 10p. Sponsored by DOE Nuclear Energy. DOE Contract AC06-76FF02170. (CONF-870102–34: 4. symposium on space nuclear power systems, Albuquerque, NM (USA), 12-16 Jan 1987). Order Number DE89014968/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A simulated space environment test of a flight prototypic SP-100 reactor, control system, and flight shield will be conducted at Westinghouse Hanford Company. The flight prototypic components and the supporting primary heat removal system are collectively known as the Test Article (TA). The unique configuration and materials of fabrication for the Test Article requires a specialized handling facility to support the installation, repair, and final disposal operations. The SP-100 Ground Engineering System (GES) Test Site focused upon those areas of the facility which were required to support the Test Article and developed requirements and concepts to handle the TA operations. The effort was hindered by the lack of requirements and a configuration for the Test Article. Subsequent changes in the Test Article configuration and interface requirements prompted a "clean look" at the Test Article and handling system requirements and concepts. Westinghouse Hanford Co., the Test Site Developer, working in conjunction with General Electric Co, the Test Article supplier, developed and evaluated several handling concepts. The result of these efforts was the selection of the Hybrid Concept for the reference Test Article Handling System. 2 refs., 7 figs.

38377 (HEDL-TME–79-79) **Evaluation of air cleaning systems for FFTF [Fast Flux Test Facility] containment margins.** Postma, A.K.; Hilliard, R.K. Hanford Engineering Development Lab., Richland, WA (USA). Aug 1980. 66p. Sponsored by DOE Nuclear Energy. DOE Contract AC06-76FF02170. Order Number DE89015757/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; GPO Dep.

Alternative air cleaning concepts were evaluated for possible application to FFTF containment margins. For evaluation purposes, it was assumed that the air cleaning system must process 3.07 m^3/s (6500 ACFM) of gas containing sodium compound aerosols (mainly NaOH) at temperatures up to 407°C (700°F) and pressures up to 0.184 MPa (26.4 psia) and accommodate 5450 kg (12,000 lb) of aerosol material. Three systems designed for 90% efficient removal (a venturi scrubber, a submerged gravel scrubber and a spray scrubber) were compared. The submerged gravel scrubber and the venturi scrubber were rated as prime candidates. Four systems designed for 99% removal efficiency (the two optimum scrubbers chosen for 90% removal efficiency fitted with fibrous elements, a sand and gravel filter and a HEPA filter bank) were compared. The two scrubbers were again rated as prime candidates. Both the sand and gravel filter and the HEPA filter bank were found to be excessively large and costly. Considerable experience supports the use of the optimum scrubber systems and it is concluded that their use is technically feasible for the FFTF containment margins application.

38378 (INIS-SU–85, pp. 63-66) **Abstract of the DOKAR computer-aided design system.** Khromov, V.V.; Kuz'min, A.M.; Anseh, V.A. and others. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1988. (In Russian). In *Nuclear reactor physics and technology. Scientific-technical collection.* Order Number DE89012154/JAW. Available from NTIS (US Sales Only), PC A05/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 2.

The DOKAR computer-aided design system for search of the optimal fast freeder reactor core arrangement is considered. Mathematical model describes interrelated and interconditioned neutron-physical, thermal and hydraulic processes in the reactor. The system operates only in the dialogue mode. The combination of the successive linearization method and the dialogue with computer is used as the optimization method. 7 refs.

38379 (WHC-SA–0096) **Preliminary upper axial shield design for space reactor ground test.** Carter, L.L.; Bunch, W.L. Westinghouse Hanford Co., Richland, WA (USA). Nov 1987. 16p. Sponsored by DOE Nuclear Energy. DOE Contract AC06-87RL10930. (CONF-8711195–6: American Nuclear Society winter meeting, Los Angeles, CA, USA, 15-19 Nov 1987). Order Number DE89014955/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A prototype of the SP-100 space reactor will be tested in a vacuum environment on the ground to verify the design prior to flight applications. Neutronic calculations are under way to design shielding that will provide the appropriate operational protection for both personnel and instrumentation, and will not compromise any important flight-type conditions of the reactor and shield system. This document describes the preliminary design of the shielding system. 1 ref., 11 figs.

38380 (WHC-SA–0546) **Vibrational characterization of hexagonal duct core assemblies under various support conditions.** Bartholf, L.W.; Julyk, L.J.; Ryan, J.A. Westinghouse Hanford Co., Richland, WA (USA). Mar 1989. 9p. Sponsored by DOE Nuclear Energy. DOE Contract AC06-87RL10930. (CONF-890855–17: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989). Order Number DE89010090/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Analysis of the dynamic response of advanced Liquid Metal Reactor (LMR) core internals to seismic excitation requires a significant number of simplifying assumptions and idealizations to economically meet the constraints of present-day computer limitations. Fluid coupling and nonlinearities associated with inter-assembly lateral support stiffness and clearances of a large cluster of core internal assemblies are some of the factors that complicate the analytical procedure (Moran, 1976). Well defined test data were needed to quantify these and other uncertainties associated with the use of analytical or numerical computer codes used in the seismic design and analysis of reactor cores. The purpose of the present experimental program was to supplement existing data, such as reported in (Sasaki and Muto, 1983), by developing vibrational characteristics of core assemblies over a range of parameters relative to LMR conceptual designs. The parameters selected for this program were variations in number and location of restraints, restraint-pad to duct-load-pad clearances, and input forcing frequency and g-level. Feature tests were conducted to characterize load pad stiffness and coefficient of restitution, and to calibrate load pads to measure inter-assembly across-flat impact loads. Simulated full-size LMR hexagonal duct core assemblies were used in vibration tests. A single assembly and a row of five assemblies were tested in air to establish modal characteristics and forced response behavior. 2 refs., 7 figs., 1 tab.

38381 **Numerical simulation of seismic sloshing of LMR reactors.** Chang, Y.W. (Argonne National Lab., IL (USA)); Gvildys, J.; Ma, D.C.; Singer, R.; Rodwell, E.; Sakurai, A. *Nuclear Engineering and Design (Netherlands),* 113(3): 435-454 (May 1989). DOE Contract W-31-109-ENG-38. (CONF-870812–: 9. biennial international conference on structural mechanics in reactor technology (SMIRT-9), Lausanne (Switzerland), 17-21 Aug 1987).

Numerical simulations of EPRI/CRIEPI sloshing experiments have been performed by Argonne National Laboratory using the ANL-developed FLUSTR computer code. The number of meshes used in the mathematical model for numerical simulation is rather small. Thus, the computing cost is relatively inexpensive. Results of numerical simulations of the sloshing responses of two test configurations which were performed by CRIEPI are described in detail. Natural frequencies and sloshing wave heights and fluid pressures at locations of sensors are calculated. The predicted values are compared with the experimental data. In all comparisons, the agreement is very good. Thus, these computer codes can be used for numerical simulation of seismic sloshing. (orig.).

2106 Power Reactors, Auxiliary, Mobile, Package, and Transportable

Refer also to citation(s) 38421, 38648

38382 (LA-UR–89-1666) **An assessment of helium gas behavior in SP-100 class reactors.** McGhee, J.; El-Genk, M.; Rothrock, R. Los Alamos National Lab., NM (USA). 1989. 6p. Sponsored by DOE Nuclear Energy. DOE Contract W-7405-ENG-36. (CONF-890815–7: 24. intersociety energy conversion engineering conference, Washington, DC, USA, 7-12 Aug 1989). Order Number DE89013452/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A theoretical investigation into the behavior of helium gas in the primary heat transport system (PHTS) of the SP-100 space nuclear power system was performed. Results indicate that helium gas dissolved in the primary coolant will most likely diffuse out of solution directly into existing bubbles in the system accumulators/gas separators before reaching a concentration sufficient to drive a nucleation process elsewhere in the loop. Differences in individual loop flow rates of only a few percent were demonstrated to have a significant impact on the relative gas diffusion rates in the loop accumulators. Small bubbles (<15 μm radius) which may escape the gas separators will not expand from temperature and pressure changes as they circulate in the PHTS. Bubbles smaller than ≈ 40 μm in radius will eventually collapse by mass diffusion. 10 refs., 6 figs., 1 tab.

2107 Regulation and Licensing

Refer also to citation(s) 38420

38383 (NUREG–0540-Vol.2-No.4) **Title list of documents made publicly available, April 1–30, 1989: Volume 2, No. 4.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Freedom of Information and Publications Services. Jun 1989. 355p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A16/MF A01 - GPO - OSTI.

This monthly publication contains descriptions of the information received and generated by the US Nuclear Regulatory Commission (NRC). This information includes (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. As used here, docketed does not refer to Court dockets; it refers to the system by which NRC maintains its regulatory records. This series of documents is indexed by a Personnel Author Index, a Corporate Source Index, and a Report Number Index. The docketed information contained in the Title List includes the information formerly issued through the Department of Energy publication Power Reactor Docket Information, last published in January 1979. Microfiche of the docketed information listed in the Title List is available for sale on a subscription basis from the National Technical Information Service (NTIS).

38384 (NUREG/CR–2000-Vol.8-No.5) **Licensee Event Report (LER) compilation, May 1989.** Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data; Oak Ridge National Lab., TN (USA). Jun 1989. 133p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. (ORNL/NSIC–200-Vol.8-No.5). Available from NTIS, PC A07/MF A01 - GPO - OSTI.

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during the one month period identified on the cover of the document. The LERs, from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. Procedures for LER reporting for revisions to those events occurring prior to 1984 are described in NRC Regulatory Guide 1.16 and NUREG-0161, Instructions for Preparation of Data Entry Sheets for Licensee Event Reports. For those events occurring on and after January 1, 1984, LERs are being submitted in accordance with the revised rule contained in Title 10 Part 50.73 of the Code of Federal Regulations (10 CFR 50.73 – Licensee Event Report System) which was published in the Federal Register (Vol. 48, No. 144) on July 26, 1983. NUREG-1022, Licensee Event Report System – Description of Systems and Guidelines for Reporting, provides supporting guidance and information on the revised LER rule.

2108 Economics

Refer also to citation(s) 38452, 38512

22 NUCLEAR REACTOR TECHNOLOGY

Refer also to citation(s) 39760

38385 (INIS-mf–11440, pp. 109-110) **Nuclear fission energy.Direct conversion into electrical energy: potential prospects.** Ursu, I. (Central Inst. of Physics, Bucharest (Romania)); Badescu-Singureanu, A.I.; Schaechter, L. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics*. Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The output parameters of Fission Electric Cells for the values of the neutron flux existing in the nuclear space reactors have been estimated on the basis of our experimental data obtained at CIP-Bucharest taking into account the nuclear fission process characteriristics and the FEC operation theory. (authors).

2201 Theory and Calculation

Refer also to citation(s) 38414, 38456, 38457, 38458, 38459, 38460

38386 Electroplating method for producing ultralow-mass fissionable deposits. Ruddy, F.H. To Dept. of Energy, Washington, DC. USA Patent 4,808,271. 28 Feb 1989. Filed date 18 Aug 1986. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

A method for producing ultralow-mass fissionable deposits for nuclear reactor dosimetry is described, including the steps of holding a radioactive parent until the radioactive parent reaches secular equilibrium with a daughter isotope, chemically separating the daughter from the parent, electroplating the daughter on a suitable substrate, and holding the electroplated daughter until the daughter decays to the fissionable deposit.

2202 Components and Accessories

Refer also to citation(s) 38347, 38402, 38413, 38425, 38428, 38447, 38753, 38754, 38814, 38817, 38991

38387 (AECL–8845) **Significance of shear and normal force components on tube wear due to fretting and periodic impacting.** Ko, P.L. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Oct 1985. 34p. (CONF-8504238–: Institute of Mechanical Engineers tribology group seminar on fretting wear, Nottingham, UK, 2-3 Apr 1985). Order Number DE89620212/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

To estimate the working life or the acceptable vibration limit for heat exchanger tubes and similar types of engineering components that are subjected to random motions, special wear prediction techniques are needed. Tube fretting wear was found to relate to the dynamic interaction, or impact force, between the tube and its support. The instantaneous reaction forces at the support were resolved into shear and normal components. Force functions derived from the shear force components were found to correlate well with the wear rates. The results show that tube fretting wear is mainly a function of the impact force and the angle of impact. Without the sliding (or shear) component, the wear rate remains low.

38388 (AIAU–88308) **Pneumatic transfer systems.** Bichler, H.; Boeck, H.; Hammer, J.; Buchtela, K. Atominstitut der Oesterreichischen Universitaeten, Vienna (Austria). Nov 1988. 15p. Order Number DE89631463/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A pneumatic transfer system for research reactors, including a sample changer system and to be used for neutron activation analysis, is described. The system can be obtained commercially from the Atominstitut. 2 figs. (qui).

38389 (CONF-890855–10) **Structural aging program to assess the adequacy of critical concrete components in nuclear power plants.** Naus, D.J.; Marchbanks, M.F.; Oland, C.B.; Arndt, E.G. Oak Ridge National Lab., TN (USA). 1989. 15p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. From 10. international conference on Structural Mechanics in Reactor Technology (SMIRT); Anaheim, CA (USA); 14-18 Aug 1989. Order Number DE89008926/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Structural Aging (SAG) Program is carried out by the Oak Ridge National Laboratory (ORNL) under sponsorship of the United States Nuclear Regulatory Commission (USNRC). The Program has evolved from preliminary studies conducted to evaluate the long-term environmental challenges to light-water reactor safety-related concrete civil structures. An important conclusion of these studies was that a damage methodology, which can provide a quantitative measure of a concrete structure's durability with respect to potential future requirements, needs to be developed. Under the SAG Program, this issue is being addressed through: establishment of a structural materials information center, evaluation of structural component assessment and repair technologies, and development of a quantitative methodology for structural aging determinations. Progress to date of each of these activities is presented as well as future plans. 7 refs., 5 figs.

38390 (CONF-890855–33) **Concrete containment analysis including thermal effects.** Pfeiffer, P.A.; Kennedy, J.M.; Marchertas, A.H. Argonne National Lab., IL (USA). 1989. 8p. Sponsored by DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From 10. international conference on Structural Mechanics in Reactor Technology (SMIRT); Anaheim, CA, USA; 14-18 Aug 1989. Order Number DE89012391/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Pretest predictions were made by the staff of the Engineering Mechanics Program at ANL for the response of the 1:6-scale reinforced concrete containment model that was tested to failure by liner tearing and leakage at the Sandia National Laboratories. Questions have been raised in regard to possible effects of temperature in combination with internal pressure on the behavior of the model. Specifically, if the containment had been subjected to elevated temperature as well as internal pressure, what differences in pressure capacity, failure mechanism and location would have been predicted when compared to the analysis of internal pressure alone. The purpose of this paper is to address these questions. 3 refs., 9 figs.

38391 (DP-MS–88-146) **Leak-before-break analysis of Type 304 stainless steel piping.** Awadalla, N.G.; Sindelar, R.L.; Daugherty, W.L.; Mehta, H.S.; Ranganath, S. Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab. 1989. 7p. Sponsored by DOE Defense Programs. DOE Contract AC09-76SR00001. (CONF-890855–20: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA, USA, 14-18 Aug 1989). Order Number DE89010460/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The nuclear materials production reactors at the Savannah River Plant (SRP) were designed and built in the 1950's and have operated successfully since that time. Unlike commercial power reactors, the production reactors are moderated and cooled by heavy water and are operated at moderately low temperatures and internal pressures. In addition, the entire primary coolant pressure boundary is constructed of Type 304 stainless steel or its cast equivalent, CF-8, except for seals, gaskets and other serviceable parts. Due to the low applied stresses coupled with high toughness, the primary coolant piping is highly tolerant of defects. In the operational history of the plant, several instances of minor leakage from stress corrosion cracks have occurred in the piping, thus exemplifying a Leak-Before-Break (LBB) capacity of the system. Fundamentally, LBB capability provides the assurance that a postulated through-wall crack could be detected by the resulting leakage before the onset of crack instability and the ensuing pipe failure. The Leak-Before-Break demonstration of the SRP primary coolant piping has been formalized through a detailed fracture assessment of postulated flaws in piping with the result that the through-wall crack length at instability conditions is well in excess of the crack length corresponding to the minimum detectable leak rate of the primary coolant system. Additional elements supporting the demonstration of SRP piping integrity include the in-service inspection program and the moderator leak detection system. The extent, frequency and method of non-destructive inspection for SRP piping conforms in general with Section XI of the ASME code and NUREG-0313 requirements for commercial Boiling Water Reactors.

38392 (EPRI-NP–6466-M) **NOREM wear-resistant, iron-based hard-facing alloys: Final report.** Grobner, P.; Ohriner, E.K.; Wada, T.; Whelan, E.P. Electric Power Research Inst., Palo Alto, CA (USA); AMAX Research and Development Center, Golden, CO (USA). c Jul 1989. 21p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Wear-resistance cobalt-free hardfacing alloys are needed to replace the cobalt-base alloys used to hardface nuclear valves in order to reduce the exposure of maintenance personnel. Some thirty heats of cast iron-base alloys were prepared and characterized. Selected heats were prepared and applied as hardfacing overlays on austenitic steel substrates using both GTA and PTA welding processes. Some of the iron-base alloys exhibited galling wear resistance as high as that of cobalt-base standards both in the cast condition and in the PTA overlays. Hardness, mechanical properties, and galling wear resistance were determined on weld overlays and on cast alloys. Dilution and thermal expansivity were determined for weld overlays. X-ray diffraction and scanning electron microscopy were used to determine the alloys' microstructures. Other commercially available alloys were tested for galling wear resistance and compared to iron-base alloys. 7 refs., 2 figs., 2 tabs.

38393 (INIS-mf–11440, pp. 2-3) **Retention of $^{137}Cs+$ ions in the presence of $^{24}Na+$ ions from a nuclear reactor coolant water by using a Vionit CS-1 PN type ion exchanger.** Alexan, Z. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering); Spiridon, S.; Rasnoveanu, I.; Pencea, C.; Fodor, G.; Paraschiv, M.; Ionescu, N.; Florea, I. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Decontamination factor values of the ion exchanger were determined. (authors).

38394 (INIS-mf–11440, pp. 4-5) **Comparison of radioactive concentration in non irradiated and gamma irradiated Vionit AS-32 and Amberlite XE-236 anion exchangers.** Alexan, Z. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering); Spiridon, S.; Rasnoveanu, I.; Pencea, C.; Fodor, G.; Paraschiv, M.; Maxim, S. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

A comparison of Vionit type ion exchangers mixed bed and an Amberlite ion exchangers mixt bed is carried out. (authors).

38395 (INIS-mf–11440, pp. 6-7) **Comparative study of the retention of the fission and corrosion radioactive ions from the VVR-S nuclear reactor coolant and moderator water by non-irradiated and gamma irradiated Vionit AS-32 and Amberlite XE-236 ion exchangers.** Alexan, Z. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering); Spiridon, S.; Rasnoveanu, I.; Pencea, C.; Fodor, G.; Paraschiv, M.; Maxim, S. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Decontamination factor values for non-irradiated and gamma irradiated Vionit S-32 and Amberlite XE-2236 columns were obtained for both anion-exchagers. (authors).

38396 (INIS-mf–11440, pp. 101-102) **Comparative study of the non-irradiated and gamma irradiated Vionit AS-32 and Amberlite XE-236 anion exchangers distribution coefficients and retention efficiencies for $^{131}I-$ and $^{99}MoO^{2-}{}_2$ ions.** Spiridon, S. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering); Alexan, Z.; Rasnoveanu, I.; Pencea, C.; Fodor, G.; Paraschiv, M.; Maxim, S. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Distribution coefficients and retention efficiencies of nonirradiated and gamma-irradiated Vionit AS-32 anion exchanger for $^{131}I-$ and $^{99}MoO^{2-}{}_2$ ions as compared to those of Amerlite XE-236 were determined . (authors).

38397 (NUREG/CR–5161-Vol.1) **Evaluation of sampling plans for in-service inspection of steam generator tubes: Modeling of eddy-current reliability data, analytical evaluations, and initial Monte Carlo simulations.** Bowen, W.M.; Heasler, P.G.; White, R.B. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Battelle Pacific Northwest Lab., Richland, WA (USA). Apr 1989. 157p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC06-76RL01830. (PNL–6462-Vol.1). Available from NTIS, PC A08/MF A01 - GPO - OSTI.

The Steam Generator Group Project (SGGP) was a multi-task effort using the retired-from-service Surry 2A pressurized water reactor steam generator as a test bed to investigate the reliability and effectiveness of in-service nondestructive eddy current (EC) inspection equipment and procedures. The information that was developed provided the technical basis for recommendations for improved in-service inspection methods and tube plugging criteria for steam generators. This report is Volume 1 of two volumes documenting the results of analyses performed to evaluate and compare candidate sampling/inspection schemes for in-service inspection of steam generator tubes. The estimated EC inspection reliability determined from round robin examination of the Surry generator was used to guide the selection of input parameters for these analyses. Analytical evaluations of candidate sampling/inspection schemes based on the ranges of probability of detection and probability of exceeding the EC plugging limit, as estimated from the round robin data, are described. Monte Carlo simulation analyses designed to supplement the analytical results and test key assumptions are presented. Finally, conclusions and recommendations for further study are presented. 2 refs., 30 figs., 27 tabs.

38398 (NUREG/CR–5231) **Cobalt-60 simulation of LOCA [loss of coolant accident] radiation effects.** Buckalew, W.H. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Sandia National Labs., Albuquerque, NM (USA). Jul 1989. 22p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (SAND–88-1054). Available from NTIS, PC A03/MF A01 - GPO - OSTI.

The consequences of simulating nuclear reactor loss of coolant accident (LOCA) radiation effects with Cobalt-60 gamma ray irradiators have been investigated. Based on radiation induced damage in polymer base materials, it was demonstrated that electron/photon induced radiation damage could be related on the basis of average absorbed radiation dose. This result was used to estimate the relative effectiveness of the mixed beta/gamma LOCA and Cobalt-60

radiation environments to damage both bare and jacketed polymer base electrical insulation materials. From the results obtained, it is concluded that present simulation techniques are a conservative method for simulating LOCA radiation effects and that the practices have probably substantially overstressed both bare and jacketed materials during qualification testing. 9 refs., 8 figs., 5 tabs.

38399 (SAND–88-2173C) **Investigation of liner tearing near penetrations in a reinforced concrete containment under severe accident loads.** Weatherby, J.R.; Clauss, D.B. Sandia National Labs., Albuquerque, NM (USA). 1989. 7p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890855–21: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989). Order Number DE89010687/JAW. Available from NTIS, PC A02/MF A01 - OSTI.

The inner surfaces of reinforced concrete containment buildings in the United States are lined with steel plate. During a severe accident, the liner plate served as the main seal for preventing the leakage of radionuclides to the outside environment, while the reinforced concrete provides structural support for the liner. If the liner is torn or punctured during the accident, gases can easily escape through cracks in the reinforced concrete wall. An overpressurization test conducted on a 1:6-scale model of a reinforced concrete containment (Horschel, 1989) has demonstrated that the liner can tear before extensive structural failure occurs in the reinforced concrete. In the 1:6-scale model experiment, the pressure inside the model was increased to 145 psig. Leakage from the model became so great that the model could not be pressurized further. Inspection of the model revealed that this leakage was due to tears that had formed in the liner at several locations around the building. All of the liner tears observed in the 1:6-scale model initiated next to studs that were used to anchor the liner to the wall of the containment. Most of the leakage occurred through a single large tear that had grown along the edge of a thickened plate that surrounded a cluster of piping penetrations. Finite element analyses were conducted to determine the mechanisms that were the primary cause of the large liner breach. 3 refs., 7 figs.

2204 Control Systems

Refer also to citation(s) 38460

38400 (IAE–4569/3) **Studying the relative efficiency of possible variants of control rod configuration for the VG-400 reactor.** Bakulin, S.V.; Bogomolov, A.M.; Glushkov, E.S. and others. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1988. 13p. (In Russian). Order Number DE89631468/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Efficiencies of several physical mockups of possible variants of the VG-400 reactor control rods, differring by material composition are measured at the GROG benchmark. Efficiencies of annular rods and squirrel-wheel type ones are measured. Effects of outer protective shield (case-steel body) and neutron spectrum hardness on relative rod efficiency are investigated. Changes of energy release distribution over rod cross-sections with variation of diameter and the spacing of absorbing element arrangement are determined. B_4C and $Dy_2O_3xTiO_5$ composition are used as absorbing materials. It is shown that increase of B_4C density from 1.5 up to 2.1 g/cm^3 and the presence of graphite bush don't affect the rod efficiencies. The presence of hydrogen-containing bush elevates the efficiencies by 5%. Efficiency is decreased by 8-10% when passing from the annular configuration to the squirrel-wheel one. 6 refs.; 6 tabs.

38401 (ZJE–279) **Systems of operational diagnostics on Czechoslovak nuclear power stations.** Kott, J.; Haniger, L.; Hubacek, Z.; Chladek, J. Skoda, Plzen (Czechoslovakia). 1988. 19p. Order Number DE89631469/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The first generation systems have already been installed at nuclear power plant Dukovany. A functional diagram of the system installed at the fourth unit of this nuclear power plant is shown. Also presented is the system designed for the nuclear power plant Mochovce, and its functional subsystems are described. Given are also the main technical features of the subsystems. A diagnostical situation is described which has occurred in the operation of the installed systems, and the analysis of measured signals is outlined. (author). 15 figs.

38402 **Passive shut-down heat removal system.** Hundal, R.; Sharbaugh, J.E. To Dept. of Energy, Washington, DC. USA Patent 4,780,270. 25 Oct 1988. Filed date 13 Aug 1986. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

An improved shut-down heat removal system of a liquid metal nuclear reactor of the type having a vessel for holding hot and cold pools of liquid sodium is disclosed herein. Generally, the improved system comprises a redan or barrier within the reactor vessel which allows an auxiliary heat exchanger to become immersed in liquid sodium from the hot pool whenever the reactor pump fails to generate a metal-circulating pressure differential between the hot and cold pools of sodium. This redan also defines an alternative circulation path between the hoot and cold pools of sodium in order to equilibrate the distribution of the decay heat from the reactor core. The inventions may take the form of a redan or barrier that circumscribes the inner wall of the reactor vessel, thereby defining an annular space therebetween. In this embodiment, the bottom of the annular space communicates with the cold pool of sodium, and the auxiliary heat exchanger is placed in this annular space just above the drawn-down level that the liquid sodium assumes during normal operating conditions. Alternatively, the redan of the invention may include a pair of vertically oriented, concentrically disposed standpipes having a piston member disposed between them that operates somewhat like a pressure-sensitive valve. In both embodiments, the cessation of the pressure differential that is normally created by the reactor pump causes the auxiliary heat exchanger to be immersed in liquid sodium from the hot pool. Additionally, the redan in both embodiments forms a circulation flow path between the hot and cold pools so that the decay heat from the nuclear core is uniformly distributed within the vessel.

2205 Environmental Aspects

Refer also to citation(s) 38443, 39156, 39291, 39600

38403 (INIS-mf–11440, pp. 578-579) **Evaluations of the environmental contamination with Cs-137, Cs-134 and Sr-90 in 1988.** Chiosila, I. (Spitalul Fundeni, Bucharest (Romania)); Chirovici, M.; Reviu, E. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Contamination level with Cs-137, Cs-134 and Sr-90 of several environmental factors two years after the nuclear accident on 26.04.1986 is presented. (authors).

38404 (INIS-mf–11440, pp. 657-658) **Dose rates from the spent fuel bays purification system at a nuclear power plant.** Stanciu, M (Institutul de Reactori Nucleari Energetici, Bucharest, Romania); Mateescu, S. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Accumulation of the activity in the ion exchanger resins for three isotopes: I-131, Cs-134, Cs-137 has been calculated. (authors).

38405 (NUREG/CR–5339) **Data summary report for fission product release test VI-1.** Osborne, M.F.; Collins, J.L.; Lorenz, R.A.; Travis, J.R.; Webster, C.S.; Yamashita, T. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research; Oak Ridge National Lab., TN (USA). Jun 1989. 59p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. (ORNL/TM–11104). Available from NTIS, PC A04/MF A01 - GPO - OSTI.

The first in a series of high-temperature fission product release test in a new vertical test apparatus was conducted in flowing steam. The test specimen was a 15.2-cm-long section of a fuel rod from the Oconee 1 PWR; it had been irradiated to a burnup of ~42 MWd/kg. Using an induction furnace, it was heated under simulated

LWR accident conditions – 20 min at 2000 K and 20 min at 2300 K – in a hot cell-mounted test apparatus. Posttest inspection showed severe oxidation but only minimal fragmentation of the fuel specimen; cladding melting was apparent only near the top end. Based on fission product measured in the fuel and/or calculated by ORIGEN, analyses of test components showed total releases from the fuel of 47% for ^{85}Kr, 33% for ^{125}Sb, 37% for ^{129}I, 84% for ^{110m}Ag, and 63% for ^{137}Cs. Large fractions (36% and 30%, respectively) of the released ^{110m}Ag and ^{125}Sb were retained in the furnace above the fuel. Pretest and posttest analysis of the fuel specimen indicated a ^{134}Cs release of 65%, which is very good agreement with the ^{137}Cs value. 21 refs., 24 figs., 16 tabs.

38406 (OEFZS–4496) **Implementing 'Source Term Code Package' on a Cyber 180-860.** Sdouz, G. Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (Austria). Mar 1989. 30p. (In German). (EA–332/89). Order Number DE89631462/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Using the STCP it is planned to investigate problems which are relevant for Austria as the source term behaviour of nuclear power plants close at the border. A CDC-version of the STCP was implemented on the CYBER 180-860 of the Technical University in Vienna. The work was complicated because of using the new system NOS/VE. This report is a compilation of the changes and improvements in the code. In addition the file administration is described. 7 refs., 7 figs.

38407 (SAND–88-7157C) **HECTR [Hydrogen Event: Containment Transient Response] assessment of the HDR [Heiss Dampf Reaktor] experiments.** Pong, L.T. Sandia National Labs., Albuquerque, NM (USA). 1989. 35p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (CONF-890819–2: ASME/AIChE national heat transfer conference, Philadelphia, PA, USA, 6-9 Aug 1989). Order Number DE89006166/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The HECTR (Hydrogen Event: Containment Transient Response) code was assessed against two large-scale thermal-hydraulic and hydrogen mixing tests (Tests 31.1 and 31.5) in the German Heiss Dampf Reaktor (HDR) decommissioned reactor facility. The HDR primary containment with a total volume of 11,300 m^3 is enclosed by a cylindrical steel shell with an overall height of 60 m and a diameter of 20 m. Unlike most US power reactor containments, the HDR containment consists of a large number (~71) of relatively small interconnected chambers. A steam and water source is injected into one of the chambers through a discharge pipe connected to the reactor pressure vessel to simulate the source in a loss of coolant accident in Tests 31.1 and 31.5. A hydrogen and helium mixture was introduced 36 minutes after the steam blowdown in Test 31.5. The specific objective of this work is to assess the transport and mixing models in the HECTR code. 9 refs., 25 figs., 1 tab.

38408 (SAND–89-1600C) **Chemical processes in fission product release and transport.** Powers, D.A. Sandia National Labs., Albuquerque, NM (USA). 1989. 23p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (CONF-890546–8: Seminar on fission product transport processes in reactor accidents, Dubrovnik, Yugoslavia, 22-26 May 1989). Order Number DE89014137/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In this paper, current trends in the continuing development of the technology for estimating the in-vessel release, transport and revaporization of radionuclides under reactor accident conditions will be described. Some of the more important sources of uncertainty and possible approaches to the resolution of these uncertainties will be discussed. 55 refs., 4 figs., 3 tabs.

38409 (WHC-SA–0503) **Control of tritium at the fast flux test facility.** Prevo, P.R. Westinghouse Hanford Co., Richland, WA (USA). Jun 1989. 6p. Sponsored by DOE Nuclear Energy. DOE Contract AC06-87RL10930. (CONF-890619–8: 34. annual meeting of the Health Physics Society, Albuquerque, NM (USA), 25-29 Jun 1989). Order Number DE89014946/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Fast Flux Test Facility (FFTF) is located on the Hanford Site near Richland, Washington, and is operated by the Westinghouse Hanford Company for the US Department of Energy (DOE). The facility features a 400 MW(t) three-loop sodium-cooled, mixed-oxide-fueled reactor that was designed for irradiation testing of fuels and materials to support the commercial development of liquid metal fast reactors. The mission has subsequently been expanded to include a passive safety test program, irradiation of fusion and space reactor materials, and isotope production. The FFTF has been in operation for about 7 yr, which includes over 1600 d of full power operation of the fast test reactor (FTR). Radiological operating experience at the FFTF has been excellent. Collective dose equivalents received by operating personnel have been very low (5 person-rem/yr average). No major contamination problems have been encountered in operating and maintaining the plant, and release of radioactivity to the environment has been well below acceptable limits (Bunch and Prevo 1987). Skin contamination events have averaged less than two per year. There have been no internal depositions. This paper discusses the generation, transport and distribution, and radiological aspects of tritium control at the FFTF. 3 refs., 1 fig., 2 tabs.

2206 Research, Test, and Experimental Reactors

Refer also to citation(s) 38363, 38415, 38418, 38421, 38443, 38757, 38795

38410 (AIAU–89304) **Inspection of the TRIGA mark-2 reactor tank Vienna in July 1988.** Boeck, H.; Hammer, J.; Klapfer, E.; Schachner, H.; Zugarek, G.; Varga, K. Atominstitut der Oesterreichischen Universitaeten, Vienna (Austria). Jan 1989. 24p. Order Number DE89631464/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

During a routine visual inspection with binoculars in spring 1988, three corrosion craters were observed on the top of the former 'thermalizing column', now being used as neutron radiography facility. The location of the corrosion craters is indicated in fig.1. As the optical resolution of the binoculars was not sufficient it was decided to ask for the support of the KFKI Budapest with its nuclear underwater telescope. The telescope and other equipment used is described and the results of the inspection are presented. It is concluded that the three major corrosion craters do not pose any safety hazard because the corrosion depth is small compared to the material thickness. However, further close monitoring of the corrosion craters is recommended. 24 figs. (qui).

38411 (JAERI-M–88-269) **Proposal for in-pile test of JAERI-developed crud separator system in the HBWR.** Itami, Hiroharu; Iimura, Katsumichi; Takasaki, Akito; Yamamoto, Katsumune; Tanaka, Hiroto; Sagawa, Hisashi; Tanaka, Isao. Japan Atomic Energy Research Inst., Tokyo (Japan). Jan 1989. 33p. Order Number DE89790941/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

JMTR Project has been developing a crud separator system for reducing personnel exposure in the JMTR since 1980. And a proof test of the crud separator system utilizing Halden Project in-pile water loop has been proposed to the Halden Project by the JMTR project. In this report, the contents of the test proposed by the JMTR project are described. Technical calculation and estimation for the crud separator system are also summarized to provide fundamental information for the proof test.

38412 (JAERI-M–89-003) **Release behavior of fission products from coated fuel particles during post-irradiation heating at abnormally high temperatures.** Hayashi, Kimio; Fukuda, Kousaku. Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1989. 56p. (In Japanese). Order Number DE89790900/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The present report describes experimental results on release behavior of metal fission-products during isochronal and isothermal heating of TRISO-and BISO-coated fuel particles at temperatures from 1400 to 2200degC. The particles were irradiated in the eighth OGL-1 fuel assembly at 1300 - 1400degC for 53.8 days up to burnups around 1% fima. Fuel particles without failed or defective coating layer in X-ray radiography were heated up one by one in a graphite electrode, whose temperature was measured by a pyrometer. The fractional releases of ^{137}Cs from the TRISO-coated fuel

particles were only around one percent, even after isothermal heating at temperatures from 1600 to 2000degC for several hundred hours. Effective retention of ^{137}Cs by the silicon-carbide layer was observed below 2000degC through comparison of its fractional releases from the TRISO-and BISO-coated fuel particles. Above 2050degC, however, fractional releases of metal fission-products from the TRISO-coated particles increased rapidly, due to thermal degradation of the SiC layer.

38413 (WHC-SA–0555) **Elevated temperature load-order effects on austenitic steel life predictions.** Weiner, E.O. Westinghouse Hanford Co., Richland, WA (USA). Mar 1989. 8p. Sponsored by DOE Nuclear Energy. DOE Contract AC06-87RL10930. (CONF-890855–18: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA, USA, 14-18 Aug 1989). Order Number DE89010091/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The design of nuclear pressure vessel components may typically involve a few hundred or more cyclic thermal loadings of various levels coupled with steady mechanical loads. Ordering of these loading events may not be detailed in the design specification. Thermal loading usually implies plastic deformation, and elevated temperature design must consider creep deformation and damage. Plastic creep solutions are history dependent. Even if some ordering is given in a design specification, practical cost considerations of inelastic analysis may impose a need to group transients. The analyst is frequently faced with the task of showing that his choice of load sequence in an elevated temperature design analysis is a conservative one. In facing such a task, the inelastic strain accumulation and creep-fatigue interaction criteria of the ASME N-47 (ASME 1986) Code Case usually govern. An effort associated with the Fast Flux Test Facility was to study the effects of load ordering the light of these criteria. The effects of a seismic disturbance were included. An additional interest was the effect of the alpha reset hardening modification (Corum, 1987), which prevents undue drift of the yield surface. An effect of reverse plasticity on subsequent creep, the beta effect, was also used. About two hundred inelastic analyses of a thin cylinder were carried out. The scope of work reported in this paper includes a study by J. Phillips (Phillips, 1982), extended with damage calculations. 4 refs., 9 figs., 2 tabs.

2207 Plutonium and Isotope Production Reactors

Refer also to citation(s) 38436, 38437

2208 Propulsion Reactors

Refer also to citation(s) 39756

38414 (UCRL–50007-87, pp. 111-122) **Criticality safety calculations for a space power reactor conceptual design study.** Pearson, J.S. Lawrence Livermore National Lab., CA (USA). Jul 1988. In *Hazards Control Department annual technology review, 1987.* Order Number DE89002470/JAW. Available from NTIS, PC A07/MF A01.

Criticality safety calculations were performed as part of a conceptual design study for a gas-cooled space power reactor. Most of the calculations are based on a beryllium oxide with uranium dioxide core, although boron carbide with uranium boride (^{11}B isotope), and carbon with uranium dicarbide were also considered. A criticality survey was made as a function of core porosity and size, and studied thermal effects on reactivity. Reactor control was considered by means of a burnable poison, a variable-leakage reflector, and internal control rods. Two accident conditions were considered: a flooded reactor and a crushed reactor. It was concluded that, with the use of retractable neutron poison wires in the core, the space power reactor can be designed to remain safely subcritical even if it is fully immersed in water or crushed. 14 references, 9 figures, 1 table.

2209 Reactor Safety

Refer also to citation(s) 38352, 38356, 38359, 38367, 38374, 38380, 38389, 38390, 38406, 38407, 38408, 39130, 39136, 39142, 39153, 39154, 39155, 39169, 39761

38415 (AIAU–88305) **Probabilistic safety analysis for the Triga reactor Vienna.** Boeck, H.; Kirchsteiger, C. Atominstitut der Oesterreichischen Universitaeten, Vienna (Austria). Jul 1988. 62p. Order Number DE89631502/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

Triga-type reactors are the most widely used low power research reactors with power levels up to 3 MW. Although Triga reactors are considered inherently safe, due to their unique features such as prompt negative temperature coefficient and low power density, the reactor core still contains a respectable amount of activity which could lead under very adverse circumstances to radiation exposure both of staff members and of public. Such circumstances could be external events, accidents during fuel element manipulation or a loss of coolant water with exposure of the core. Therefore, it was decided to look more closely to various accident pathways and to calculate their probability, if possible. A major drawback is the lack of statistical material because no centralized registration of failures is carried out. Therefore, in many cases values from other research reactor types or even from power reactor statistics had to be used, thus increasing the uncertainty of the results. As most undesired event or TOP-event in this analysis a radiation exposure of staff members, the public or both together was selected and the probabilities of different pathways leading to this exposure was calculated. In the present case 'radiation exposure' are dose rates or activity concentration above the international accepted limits for occupational staff or public. 20 refs., 10 figs.

38416 (BALUF-STS–88-03) **Tests of a HPGe gamma spectrometry equipment to be used in an airplane for surface monitoring.** Henrich, E. Bundesanstalt fuer Lebensmitteluntersuchung und -forschung, Vienna (Austria). Sep 1988. 9p. (In German). Order Number DE89631292/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

In view of searching for radioactive satellite fragments, from an airplane, an Entertec-Schlumberger germanium detector and a multichannel analyzer were mounted in a slow-flying plane. Co-60- and Ir-192 sources with strengths in the 100 mCi range were placed at ground. The plane cruised, at 100 knots speed, 100 and 200 m above the ground. The detection of fragments of these activities is shown to be feasible. 2 figs., 1 tab. (qui).

38417 (BMU–1988-185) **Occupational radiation exposure of personnel in German light-water type nuclear power plant in the year 1985.** Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten. Urbahn, H.; Mueller, W.; Marx, H. Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.). Feb 1988. 214p. (In German). Contract BMU St.Sch. 00974;GRS 83400. Available from GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.).

1985 was a good year with regard to radiation protection for the German nuclear power stations with BWR and PWR. There were favourable values for the collective dose. There was an increase in the collective dose only in some power plants because of dose-intensive repair, replacement and retrofit work. The average personal doses of the internal staff as well as of the external staff showed quite favourable values also in comparison to the previous years. The increased average personal doses occurred generally in the older plants. This is caused, on the one hand, by dose-intensive repair, replacement and retrofit work, on the other hand, it reflects the different deployment of labour. The dose values for the job doses of the inspection and maintenance work were within the range of the empirical and expected values. High dose values occurred in general only in retrofit measures, which were carried out namely because of obligations by the regulatory authority. Only a small proportion of the collective dose was due to repair work. In the case of the BWR, the dose values for the job doses of fuel element replacement, maintenance and inspection work were within the range of the empirical and expected values. Retrofit and repair work did not contribute much to the collective dose. (orig./HP).

38418 (BNL-NUREG–42081) **MELCOR simulation of the PBF [Power Burst Facility] severe fuel damage test 1-1.** Madni, I.K. Brookhaven National Lab., Upton, NY (USA). 1989. 18p. Sponsored

by Nuclear Regulatory Commission. DOE Contract AC02-76CH00016. (CONF-890819–7: ASME/AIChE national heat transfer conference, Philadelphia, PA (USA), 6-9 Aug 1989). Order Number DE89009531/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper describes a MELCOR version 1.7.1 simulation of the Power Burst Facility (PBF) Severe Fuel Damage (SFD) 1-1 test. The input data for the simulation was obtained from the SFD 1-1 Test Results Report and from SCDAP input. Results are presented for the transient two-phase interface level in the core, fuel and clad temperatures at various elevations in the fuel bundle, clad oxidation, hydrogen generation, fission product release, and heat transfer to the surrounding structures. Comparisons are made with experimental data and predictions from STCP and the NRC's mechanistic code SCDAP (version 18). 6 refs., 12 figs.

38419 (BNL-NUREG–42674) **Component fragility data base for reliability and probability studies.** Bandyopadhyay, K.; Hofmayer, C.; Kassir, M.; Pepper, S. Brookhaven National Lab., Upton, NY (USA). [1989]. 6p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC02-76CH00016. (CONF-890855–42: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA, USA, 14-18 Aug 1989). Order Number DE89012668/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Safety-related equipment in a nuclear plant plays a vital role in its proper operation and control, and failure of such equipment due to an earthquake may pose a risk to the safe operation of the plant. Therefore, in order to assess the overall reliability of a plant, the reliability of performance of the equipment should be studied first. The success of a reliability or a probability study depends to a great extent on the data base. To meet this demand, Brookhaven National Laboratory (BNL), under a sponsorship of the United States Nuclear Regulatory Commission (USNRC), has formed a test data base relating the seismic capacity of equipment specimens to the earthquake levels. Subsequently, the test data have been analyzed for use in reliability and probability studies. This paper describes the data base and discusses the analysis methods. The final results that can be directly used in plant reliability and probability studies are also presented in this paper. 2 refs., 2 tabs.

38420 (BNL-NUREG–42788) **Review of public comments on proposed seismic design criteria.** Philippacopoulos, A.J.; Shaukat, S.K.; Chokshi, N.C.; Bagchi, G. Brookhaven National Lab., Upton, NY (USA). 1989. 7p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC02-76CH00016. (CONF-890855–48: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989). Order Number DE89014191/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

During the first quarter of 1988, the Nuclear Regulatory Commission (NRC) prepared a proposed Revision 2 to the NUREG-0800 Standard Review Plan (SRP) Sections 2.5.2 (Vibratory Ground Motion), 3.7.1 (Seismic Design Parameters), 3.7.2 (Seismic Systems Analysis) and 3.7.3 (Seismic Subsystem Analysis). The proposed Revision 2 to the SRP was a result of many years' work carried out by the NRC and the nuclear industry on the Unresolved Safety Issue (USI) A-40: "Seismic Design Criteria." The background material related to NRC's efforts for resolving the A-40 issue is described in NUREG-1233. In June 1988, the proposed Revision 2 of the SRP was issued by NRC for public review and comments. Comments were received from Sargent and Lundy Engineers, Westinghouse Electric Corporation, Stevenson and Associates, Duke Power Company, General Electric Company and Electric Power Research Institute. In September 1988, Brookhaven National Laboratory (BNL) and its consultants (C.J. Costantino, R.P. Kennedy, J. Stevenson, M. Shinozuka and A.S. Veletsos) were requested to carry out a review of the comments received from the above six organizations. The objective of this review was to assist the NRC staff with the evaluation and resolution of the public comments. This review was initiated during October 1988 and it was completed on January 1989. As a result of this review, a set of modifications to the above mentioned sections of the SRP were recommended by BNL and its consultants. This paper summarizes the recommended modifications. 4 refs.

38421 (CONF-880122–23) **A novel plant protection strategy for transient reactors.** Bhattacharyya, S.K.; Lipinski, W.C.; Hanan, N.A. Argonne National Lab., IL (USA). 1988. 17p. Sponsored by DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From 5. symposium on space nuclear power systems; Albuquerque, NM, USA; 11-14 Jan 1988. Order Number DE89013652/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Reactors operating in the controlled transient mode have been proposed for burst-mode power generation in support of Strategic Defense Initiative applications. Because the safety and reliability of the reactor system is of critical importance, the successful design and testing of an effective reactor control and Plant Protection System (PPS) will undoubtedly be crucial to the adoption of these power systems. In this paper we will describe a novel plant protection systems designed for use in the TREAT Upgrade (TU) reactor. The TU reactor (Wade et al. 1982) is designed for controlled transient operation for the testing of reactor fuel behavior under simulated reactor accident conditions. Safe operation of the reactor is of paramount importance and the PPS had to be designed to exacting requirements. The need to meet demanding functional requirements within several major constraints has produced a design that has a relatively small margin between operating and damaging temperature conditions for the TREAT fuel clad. A plant protection system with energy-dependent trip set points lowered worst-case clad temperatures by as much as 180K, as compared with the use of conventional fixed-level trip set points. We believe that the multilayered multilevel protection strategy developed for TU represents the state of the art in terrestrial transient reactor protection systems, and has potential application to the multimegawatt space reactors. 5 refs., 6 figs., 2 tabs.

38422 (CONF-890855–8) **High-level seismic tests of piping at the HDR [Heissdampfreaktor].** Kot, C.A.; Srinivasan, M.G.; Hsieh, B.J.; Costello, J.F. Argonne National Lab., IL (USA). 1989. 19p. Sponsored by Nuclear Regulatory Commission. DOE Contract W-31109-ENG-38. From 10. international conference on Structural Mechanics in Reactor Technology (SMIRT); Anaheim, CA (USA); 14-18 Aug 1989. Order Number DE89009781/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

As part of the second-phase testing at the Heissdampfreaktor (HDR) Test Facility in Kahl/Main, Federal Republic of Germany (FRG), high-level seismic experiments, designated SHAM, were performed on an in-plant piping system during the period of 19 April to 27 May 1988. The objectives of the SHAM experiments were to (1) study the response of piping subjected to seismic excitation levels that exceed design levels manifold and which may result in failure/plastification of pipe supports and pipe elements; (2) provide data for the validation of linear and nonlinear pipe response analyses; (3) compare and evaluate, under identical loading conditions, the performance of various dynamic support system, ranging from very flexible to very stiff support configurations; (4) establish seismic margins for piping, dynamic pipe supports, and pipe anchorages; and (5) investigate the response, operability, and fragility of dynamic supports and of a typical US gate valve under extreme levels of seismic excitation. A brief description of the SHAM tests is provided, followed by highlights of the test results that are given primarily in the form of maximum response values. Also presented are very limited comparisons of experimental data and pretest analytical predictions. 6 refs., 8 figs.

38423 (CONF-890855–34) **Seismicity and seismic response of the Soviet-designed VVER [Water-cooled, Water moderated Energy Reactor] reactor plants.** Ma, D.C.; Gvildys, J.; Wang, C.Y.; Spencer, B.W.; Sienicki, J.J.; Seidensticker, R.W.; Purvis, E.E. III. Argonne National Lab., IL (USA). 1989. 7p. Sponsored by DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From 10. international conference on Structural Mechanics in Reactor Technology (SMIRT); Anaheim, CA (USA); 14-18 Aug 1989. Order Number DE89012379/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

On March 4, 1977, a strong earthquake occurred at Vrancea, Romania, about 350 km from the Kozloduy plant in Bulgaria. Subsequent to this event, construction of the unit 2 of the Armenia plant was delayed over two years while seismic features were added. On

December 7, 1988, another strong earthquake struck northwest Armenia about 90 km north of the Armenia plant. Extensive damage of residential and industrial facilities occurred in the vicinity of the epicenter. The earthquake did not damage the Armenia plant. Following this event, the Soviet government announced that the plant would be shutdown permanently by March 18, 1989, and the station converted to a fossil-fired plant. This paper presents the results of the seismic analyses of the Soviet-designed VVER (Water-cooled, Water moderated Energy Reactor) plants. Also presented is the information concerning seismicity in the regions where VVERs are located and information on seismic design of VVERs. The reference units are the VVER-440 model V230 (similar to the two units of the Armenia plant) and the VVER-1000 model V320 units at Kozloduy in Bulgaria. This document provides an initial basis for understanding the seismicity and seismic response of VVERs under seismic events. 1 ref., 9 figs., 3 tabs.

38424 (CONF-890855–36) **Computer graphics in reactor safety analysis.** Fiala, C.; Kulak, R.F. Argonne National Lab., IL (USA). 1989. 7p. Sponsored by DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From 10. international conference on Structural Mechanics in Reactor Technology (SMIRT); Anaheim, CA (USA); 14-18 Aug 1989. Order Number DE89012424/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper describes a family of three computer graphics codes designed to assist the analyst in three areas: the modelling of complex three-dimensional finite element models of reactor structures; the interpretation of computational results; and the reporting of the results of numerical simulations. The purpose and key features of each code are presented. The graphics output used in actual safety analysis are used to illustrate the capabilities of each code. 5 refs., 10 figs.

38425 (CONF-890855–37) **Posttest analysis of the 1:6-scale reinforced concrete containment.** Pfeiffer, P.A.; Kennedy, J.M.; Marchertas, A.H. Argonne National Lab., IL (USA). 1989. 8p. Sponsored by DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From 10. international conference on Structural Mechanics in Reactor Technology (SMIRT); Anaheim, CA, USA; 14-18 Aug 1989. Order Number DE89012389/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A prediction of the response of the Sandia National Laboratories 1:6- scale reinforced concrete containment model test was made by Argonne National Laboratory. ANL along with nine other organizations performed a detailed nonlinear response analysis of the 1:6-scale model containment subjected to overpressurization in the fall of 1986. The two-dimensional code TEMP-STRESS and the three-dimensional NEPTUNE code were utilized (1) to predict the global response of the structure, (2) to identify global failure sites and the corresponding failure pressures and (3) to identify some local failure sites and pressure levels. A series of axisymmetric models was studied with the two-dimensional computer program TEMP-STRESS. The comparison of these pretest computations with test data from the containment model has provided a test for the capability of the respective finite element codes to predict global failure modes, and hence serves as a validation of these codes. Only the two-dimensional analyses will be discussed in this paper. 3 refs., 10 figs.

38426 (CONF-890855–38) **Impact of insufficient energy content in the design time history on the structure response.** Ma, D.C.; Gvildys, J.; Chang, Y.W.; Seidensticker, R.W. Argonne National Lab., IL (USA). 1989. 7p. Sponsored by DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From 10. international conference on Structural Mechanics in Reactor Technology (SMIRT); Anaheim, CA (USA); 14-18 Aug 1989. Order Number DE89013173/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In the design of nuclear power plants, it is often desirable to use the time history method in the soil-structure interaction analysis to determine the plant floor response to seismic loads. Because many design criteria are specified in terms of design response spectra, the artificial time history needs to be generated under the requirement that the response spectra of the artificial history should envelop the given design response spectra. However, recent studies indicate that the artificial time history used in the plant design may have insufficient energy in the frequency range of interest, even though the response spectra of the design time history closely envelop the design response spectra. Therefore, the proposed changes in the NRC Standard Review Plan requires that when a single time history is used in the seismic design, it must satisfy requirements for both response spectra enveloping and matching a power spectra density (PSD) function in the frequency range of interest. The use of multiple artificial time histories (at least five time histories) in the plant design is also suggested in the new Standard Review Plan. This paper presents an investigation of the effects of the insufficient energy content in the design time history on the response of the soil-structure system. Numerical studies were carried out. Both the real earthquake records and the artificial time histories were used as the input motions in a simple lumped-mass soil-structure interaction model. The results obtained from this study provide a better understanding of the effects of the insufficient energy content in the design time history on the structural response. 5 refs., 10 figs., 1 tab.

38427 (CONF-890855–39) **Response of Soviet VVER-440 accident localization systems to overpressurization.** Kulak, R.F.; Fiala, C.; Sienicki, J.J. Argonne National Lab., IL (USA). 1989. 6p. Sponsored by DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From 10. international conference on Structural Mechanics in Reactor Technology (SMIRT); Anaheim, CA (USA); 14-18 Aug 1989. Order Number DE89013195/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Soviet designed VVER-440 model V230 and VVER-440 model V213 reactors do not use full containments to mitigate the effects of accidents. Instead, these VVER-440 units employ a sealed set of interconnected compartments, collectively called the accident localization system (ALS), to reduce the release of radionuclides to the atmosphere during accidents. Descriptions of the VVER accident localization structures may be found in the report DOE NE-0084. The objective of this paper is to evaluate the structural integrity of the VVER-440 ALS at the Soviet design pressure, and to determine their response to pressure loadings beyond the design value. Complex, three-dimensional, nonlinear, finite element models were developed to represent the major structural components of the localization systems of the VVER-440 models V230 and V213. The interior boundary of the localization system was incrementally pressurized in the calculations until the prediction of gross failure. 6 refs., 9 figs.

38428 (EGG-M–88343) **The effect of plastic behavior on damping in piping systems.** Ware, A.G. EG and G Idaho, Inc., Idaho Falls, ID (USA). 1989. 6p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC07-76ID01570. (CONF-890855–15: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA, USA, 14-18 Aug 1989). Order Number DE89009739/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Due to energy dissipated by plastic action, the equivalent damping that must be used in stress analyses to predict moments and stresses is much higher than damping for elastic response. High strain damping data from eight different sources were plotted on a common basis as a function of ductility to estimate damping levels at system failure. At the strain levels when systems fail, equivalent damping values are estimated to be 30 to 50% of critical. This results in a response margin of actual input acceleration to linear elastic computed acceleration (using 5% of critical damping) of from 2.5 to 3 for seismic excitations and from 6 to 10 for sinusoidal excitations. 6 refs., 6 figs., 1 tab.

38429 (EGG-M–88346) **Effects of blowdown flows on isolation valve operability.** DeWall, K.G. EG and G Idaho, Inc., Idaho Falls, ID (USA). 1989. 7p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC07-76ID01570. (CONF-890855–24: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA, USA, 14-18 Aug 1989). Order Number DE89010996/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper presents the results of the USNRC/INEL testing of isolation valves under high-temperature/pressure boiling water reactor (BWR) line break conditions. The purpose of the testing was to provide input to the technical basis for resolving the NRC's Generic Issue 87. Two representative nuclear valve assemblies were cycled

under design basis conditions simulating a pipe break in the reactor water cleanup supply line. The effect of the resulting hydraulic loadings on valve operability, especially stem forces during valve closure, were studied. Both valves isolated flow during all tests; however, valve stem forces were much higher than anticipated. Tests showed that proper operator sizing and torque switch settings depend on the identification of correct values for the sizing equations, and that values used in the past may not be conservative for all valve applications. 6 figs.

38430 (EGG-M–88347) **Valve and piping system test results and effects on regulatory standards.** Steel, R. Jr. EG and G Idaho, Inc., Idaho Falls, ID (USA). 1989. 7p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC07-76ID01570. (CONF-890855–25: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA, USA, 14-18 Aug 1989). Order Number DE89010997/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Idaho National Engineering Laboratory (INEL), under the sponsorship of the US Nuclear Regulatory Commission (USNRC), is performing research to provide a technical basis for the resolution of specific generic issues and severe accident concerns and to provide information that will help to develop and improve mechanical equipment qualification standards. Research results are being used for improving plant safety at design basis loadings and for quantifying safety margins for severe accident loadings. This paper summarizes the objectives, the research, selected results, and regulatory applications for the following four INEL research tasks: Nuclear Containment Purge and Vent Valves Closing in Design Basis Loss-of-Coolant Accident (LOCA) Environment, Valve and Snubber Operability and Piping Support Fragility Experiments, Nuclear Containment Piping Penetrations and Isolation Valve Response to Design Basis and Severe Accident Loadings, and Gate Valve Closing Requirements in a High Energy Boiling Water Reactor (BWR) Line Break.

38431 (EGG-M–89042) **Severe accident containment design requirements for advanced light water reactors.** Fontana, M.H. EG and G Idaho, Inc., Idaho Falls, ID (USA). 1989. 7p. Sponsored by DOE Nuclear Energy. DOE Contract AC07-76ID01570. (CONF-890819–13: ASME/AIChE national heat transfer conference, Philadelphia, PA, USA, 6-9 Aug 1989). Order Number DE89010973/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The DOE Advanced Reactor Severe Accident Program has as its objective the resolution of severe accident issues, and in conjunction with the nuclear industry and EPRI is providing solutions to the key issues. ALWRs can take advantage of design solutions to accommodate severe accident sequences and phenomena that are important potential risk contributors. Design solutions to the key issues of hydrogen generation and burn, direct containment heating, and debris coolability have been developed and are discussed. 10 refs.

38432 (EML–504, pp. 17-21) **Chernobyl-related deposition projects.** Juzdan, Z.R.; Larsen, R.J. USDOE Environmental Measurements Lab., New York, NY (USA). Oct 1988. In *1985-86 biennial report of the EML regional baseline station at Chester, New Jersey.* Order Number DE89002705/JAW. Available from NTIS, PC A09/MF A01.

Since 1957, EML has maintained a global network of sampling stations where fallout is collected for measurement of ^{90}Sr. The Chester, NJ site has been part of this global network since 1976. For ~ 1 month following the nuclear reactor accident at the Chernobyl reactor station in the U.S.S.R. on April 26, 1986, EML increased the frequency of fallout collections at a number of its network sites, including Chester. Our goal was to characterize the radioactive debris from Chernobyl and estimate regional fallout patterns. Three deposition collection projects were performed at Chester during May 1986. Projects 1 and 2 involved collecting deposition to measure gamma emitting radionuclides, such as ^{131}I, ^{134}Cs, and ^{137}Cs. The main differences between projects 1 and 2 are in the sampling protocols and in the interpretation of the statistical data. Project 2 consisted of dry and bulk deposition collections, which enabled us to calculate deposition velocities from dry deposition rates and surface air concentrations. Project 3 used the monthly bulk deposition samples collected for the global fallout program and measured them for two beta emitters, ^{89}Sr and ^{90}Sr.

38433 (EUR–12048) **Benchmark experiments to simulate a nuclear transport flask loading accident with fuel elements of unequal reactivity.** Stevenson, J.M.; Franklin, B.M.; Burbidge, B.L.H.; Prescott, A.; Poullot, G. Commission of the European Communities, Luxembourg (Luxembourg). 1989. 57p. Available from NTIS (US Sales Only), PC A04/MF A01.

A series of measurements have been completed in the DIMPLE light water-moderated, low-power reactor at AEE Winfrith, to simulate a transport flask loading error. The experiments were designed in collaboration with the CEA at Fontenay-aux-Roses, with the aim of testing current calculational methods in extreme accident configurations. The programme was based on a 20 compartment boron-steel skip. This is used inside a steel container for pond storage of irradiated fuel from the UK Advanced Gas-Cooled Reactors (AGR's) and this in turn is placed inside a lead-lined steel flask for fuel transport. Prior to the critical experiments a comprehensive range of sub-critical benchmarks had been established using the skip. The reference loading for the sub-critical studies and the present accident simulation had identical arrays of 3% enriched uranium oxide pins loaded into each of the 20 skip compartments. To simulate a gross loading error, a cluster of 7% enriched uranium oxide pins replaced the lower enrichment pins in one of the compartments, firstly in one of those at the centre and then in one at the edge. The experiments established the critical water heights in each configuration and, to provide valuable diagnostic data, measurements were also made of the U235 and U238 fission rate and the U238 capture rate distributions in each case. The assemblies, the results of the measurements and their comparison with predictions using the MONK 6.3 and MORET Monte Carlo codes and the deterministic LWRWIMS-TWOTRAN code are given.

38434 (GA-A–19714) **The safety approach of the modular high-temperature gas-cooled reactor (MHTGR).** Silady, F.A.; Parme, L.L. General Atomics, San Diego, CA (USA). Jun 1989. 15p. Sponsored by DOE Nuclear Energy. DOE Contract AC03-89SF17885. (CONF-8906158–1: 11th international conference on he HTGR, DIMITROVGRAD, USSR, 19-20 Jun 1989). Order Number DE89014031/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Modular High-Temperature Gas-Cooled Reactor (MHTGR) is an advanced reactor concept under development in a cooperative program involving the US Government, the nuclear industry, and the utilities. The design utilizes the basic high-temperature gas-cooled reactor (HTGR) features of ceramic fuel, helium coolant, and a graphite moderator. However, the specific size and configuration of the MHTGR are selected to utilize the inherent characteristics of these materials to develop passive safety features that provide a significantly higher margin of safety than current generation reactors. The design meets the US Environmental Protection Agency's Protective Action Guidelines at the site boundary, hence precluding the need for sheltering or evacuation of the public during any licensing basis event. This safe behavior is not dependent upon operator action, is insensitive to operator error, and does not require a leak tight containment building. A safety summary is provided of the response to events challenging the functions relied on to retain radionuclides within the coated fuel particles. The regulatory interaction process and results are discussed through reviews of the Nuclear Regulatory Commission (NRC) staff, NRC contractor and Advisory Committee for Reactor Safeguards (ACRS). Insights from the NRC's Draft Safety Evaluation Report are discussed. 4 refs., 9 figs.

38435 (HEDL-SA–3701) **Radiological operating experinece at FFTF.** Bunch, W.L.; Prevo, P.R. Westinghouse Hanford Co., Richland, WA (USA). Mar 1987. 8p. Sponsored by DOE Nuclear Energy. DOE Contract AC06-76FF02170. (CONF-870917–16: ANS/ENS international conference on fast breeder reactor systems: experience gained and path to economical power generation, Richland, WA (USA), 13-17 Sep 1987). Order Number DE89014952/JAW. Available from NTIS, PC A02/MF A01 - OSTI.

The Fast Flux Test Facility (FFTF) has been in operation for approximately five years, including over eleven hundred days of full power operation of the Fast Test Reactor (FTR). During that time the collective dose equivalents received by operating personnel

have been about two orders of magnitude lower than those typically received at commercial light water reactors. No major contamination problems have been encountered in operating and maintaining the plant, and release of radioactive gas to the environment has been well below acceptable limits. All shields have performed satisfactorily. Experience to date indicates an apparent radiological superiority of liquid metal reactor systems over current light water plants. 5 refs., 6 tabs.

38436 (HW–36226) **Minutes of meeting with Advisory Committee on Reactor Safeguards, December 6–7, 1954.** Dickeman, R.L. General Electric Co., Richland, WA (USA). Hanford Atomic Products Operation. 14 Apr 1955. 36p. Sponsored by DOE Defense Programs. DOE Contract AC06-76RL01830. Order Number DE89013135/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

Declassified 14 Jun 1989.

The information presented to the Advisory Committee on Reactor Safeguards during the December 6 and 7 meeting is briefly summarized as are the assumptions and methods used in developing the information. References are given to the published work and/or the individuals who developed the data. The primary subjects discussed were: (1) status of the production piles and contemplated future conditions of irradiation; (2) review of pile reactivity status, operating procedures and available control; (3) instrumentation status and development; (4) the effect on pile reactivity, power and components upon loss of coolant; (5) status of safety fuse application and development; (6) problems in the maintenance of coolant including the design and cost of possible disaster control systems; (7) catastrophe experimentation; and (8) possible nuclear hazards associated with the operation of the prototype Physical Constants Test Reactor. 13 refs., 14 figs., 3 tabs.

38437 (HW–36621) **Recommendations by Advisory Committee on Reactor Safeguards.** Greager, O.H. General Electric Co., Richland, WA (USA). Hanford Atomic Products Operation. 6 May 1955. 8p. Sponsored by DOE Defense Programs. DOE Contract AC06-76RL01830. Order Number DE89013134/JAW. Available from NTIS, PC A02/MF A01 - OSTI.

Declassified 14 Jun 1989.

Our general comments regarding each of the recommendations made by the Advisory Committee on Reactor Safeguards following the December 6 and 7 meeting are transmitted in the nature of an interim reply as per your request. It is noted that the recommendations primarily define areas of reactor safety into which the committee recommends that future studies be channeled and that these areas are consistent with programmed extensions of the work presented at the December 6 and 7 meeting. The general comments contained herein include a brief summary of our current status on each of the items suggested by the Committee.

38438 (INIS-mf–11480, pp. 33) **Project pebble-bed reactor.** Mueller, H. (Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik); Ninaus, W.; Oswald, K.; Rabitsch, H.; Schuerrer, F.; Sgouridis, S.; Neef, R.D.; Schaal, H. Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik. Nov 1988. (In German). In *Annual report of the Institute for Theoretical Physics in Graz, Austria.* Order Number DE89631627/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

PEBBLE BED REACTORS/reactor accidents; REACTOR SAFETY; SHUTDOWNS; PROGRESS REPORT

38439 (KEMA–19875) **Core-melting accidents in Chernobyl and Harrisburg. Lessons for reactor safety.** Loon, A.J. van; Vonderen, A.C.M. van (Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands)) (eds.). Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands). 1987. 130p. (In Dutch). Order Number DE89631285/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Includes list of acronyms.

This publication deals with the essences of the reactor accident in Chernobylsk and the conclusions to be drawn from these with regard to reactor safety. Therein the technical differences between the reactor types in the West and the East play an important role. Also attention is spent to the now generally accepted philosophy that by simplification and making use of proven technologies, a further deminishing of the risks can be achieved step by step. In ch.'s 2 and 4 the origin and course of the accidents in respectively Chernobylsk and Harrisburg are analyzed; in the analysis of the Chernobylsk accident also date have been used which were provided by the Sovjet-Union, supplied with results of studies of the U.S. Department of Energy (DOE). In ch. 3 this information is compared with the insights which have grown at KEMA about these on the base of reactor physical and thermohydraulic considerations and of computer calculations reproducing the course of the accident. An important question is if, and if so: to which extent, an accident such as the one in Chernobylsk also can take place in the West. In order to answer that question as accurate as possible the consequences of core meltings accidents and the risk for such an accident taking place are pursued. In ch. 6 the legal frameworks are indicated by which the risk may be limited and by which eventually yet occurring damage may be arranged. Ch. 7 finally deals with the lessons which the accidents in Chernobylsk and Harrisburg have taught us and with the possible consequences of these for the further application of nuclear power in the Netherlands. (H.W.). 105 refs.; 42 figs.; 17 refs.

38440 (LA-UR–89-1120) **An overview of an experimental program for testing large reinforced concrete shear walls.** Farrar, C.R.; Bennett, J.G. Los Alamos National Lab., NM (USA). 1989. 6p. Sponsored by Nuclear Regulatory Commission. DOE Contract W-7405-ENG-36. (CONF-890855–7: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA, USA, 14-18 Aug 1989). Order Number DE89009250/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Seismic Category I Structures Program is being carried out at the Los Alamos National Laboratory under sponsorship of the US Nuclear Regulatory Commission (NRC), Office of Nuclear Regulatory Research. In the class of structure being investigated, the primary lateral load-resisting structural element is the reinforced concrete shear wall. Previous results from microconcrete models indicated that these structures responded to seismic excitations with initial frequencies that were reduced by factors of 2 or more over those calculated based on an uncracked cross-section strength-of-materials approach. Furthermore, though the structures themselves were shown to have sufficient reserve margins, the equipment and piping are designed to response spectra that are based on uncracked cross-sectional member properties, and these spectra may not be inappropriate for actual building responses. The current phase of the program is aimed at verification of these conclusions using conventional concrete structures to demonstrate that previous microconcrete results can be scaled to prototype structures. A new configuration of a shear wall structure was designed and tested to investigate the analytical-experimental differences observed during the previous model testing. Shear wall height-to-length aspect ratios were to vary from 1 to 0.25. Percentage steel ratios were to vary from 0.25% to 0.6% by area, in both horizontal and vertical directions. The test structures are shown in Fig. 1. TRG-1 and -2 were constructed with microconcrete. TRG-3, -4, -5, and -6 were constructed with conventional (19-mm aggregate) concrete. 11 refs., 4 figs.

38441 (NUREG–1217) **Evaluation of safety implications of control systems in LWR nuclear power plants: Technical findings related to USI A-47: Final report.** Szukiewicz, A.J. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Issue Resolution. Jun 1989. 57p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A04/MF A01 - GPO - OSTI.

An in-depth evaluation was performed on non-safety-related control systems (see Section 1) that are typically used during normal plant operation on four nuclear steam supply system plants: a General Electric Company boiling-water reactor, a Westinghouse 3-loop pressurized-water reactor (PWR), a Babcock & Wilcox Co. (B&W) once-through steam generator PWR, and a Combustion Engineering PWR design. A study was also conducted to determine the generic applicability of the results to the class of plants represented by the specific plants analyzed. Generic conclusions were then developed. Steam generator and reactor vessel overfill events and reactor vessel overcooling events were identified as major classes of events having the potential to be more severe than previously analyzed.

Specific substasks of this issue were to study these events to determine the need for preventive and/or mitigating design measures. This report describes the technical studies performed by the laboratories, the NRC staff assessment of the results, the generic applicability of the evaluations, and the technical findings resulting from these studies. This final report contains the staff's responses to, and resolution of, the public comments that were solicited and received before September 16,1988, in response to the draft reports issued for public comment on May 27, 1988. 39 refs, 1 fig., 7 tabs.

38442 (NUREG/CR–5118) **Leak and structural test of personnel airlock for LWR [light water reactor] containments subjected to pressures and temperatures beyond design limits.** Julien, J.T.; Peters, S.W. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Sandia National Labs., Albuquerque, NM (USA); CBI Research Corp., Plainfield, IL (USA). May 1989. 157p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (SAND–88-7155). Available from NTIS, PC A08/MF A01 - GPO - OSTI.

As part of the US Nuclear Regulatory Commission's (USNRC) Containment Integrity Program, tests were performed on a full-size personnel airlock for a nuclear containment building to determine its leakage potential and to measure its structural and thermal response. The airlock was subjected to conditions simulating severe accident conditions. Testing was performed by CBI Research Corporation (CBIRC) under contract to Sandia National Laboratories (SNL), which manages the Containment Integrity Program for the USNRC. The objective of the test was to characterize the performance of airlock door seals when subjected to conditions that simulate a severe accident condition. The seals were aged at an accelerated rate to simulate aging that might occur during 40 years of continuous service and a loss of coolant accident (LOCA). The data obtained from this test will be used by SNL as a benchmark for development of analytical methods. Leak rate, strain, temperature, displacement, and pressure data were measured and recorded from over 330 transducers. A total of nine tests were performed on the airlock. During the beyond-design-basis test, the inner door and bulkhead of the airlock were exposed to a maximum surface pressure of 300 psig (2.07 MPa) and a maximum surface temperature on the door of 783°F (417°C). The remaining eight tests were performed at ambient temperatures and at air pressures on the airlock doors up to 69 psig (476 kPa). These tests were conducted to provide reference points for leakage under design conditions, to estimate the need for and effectiveness of the gaskets, and to characterize the post-severe accident behavior of the airlock. 13 refs., 84 figs., 9 tabs.

38443 (NUREG/CR–5163) **Power Burst Facility (PBF) severe fuel damage test 1-4 test results report.** Petti, D.A.; Martinson, Z.R.; Hobbins, R.R.; Allison, C.M.; Carlson, E.R.; Hagrman, D.L.; Cheng, T.C.; Hartwell, J.K.; Vinjamuri, K.; Seifken, L.J. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research; EG and G Idaho, Inc., Idaho Falls, ID (USA). Apr 1989. 498p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC07-76ID01570. (EGG–2542). Available from NTIS, PC E16/MF E02 - GPO - OSTI.

Includes 9 sheets of 24X reduction microfiche.

A comprehensive evaluation of the Severe Fuel Damage (SFD) Test 1-4 performed in the Power Burst Facility (PBF) at the Idaho National Engineering Laboratory is presented. Test SFD 1-4 was the fourth and final test in an internationally sponsored light water reactor severe accident research program, initiated by the US Nuclear Regulatory Commission. The overall technical objective of the test was to contribute to the understanding of fuel and control rod behavior, aerosol and hydrogen generation, and fission product release and transport during a high-temperature, severe fuel damage transient. A test bundle, comprised of 26 previously irradiated (36,000 MWd/MtU) pressurized water-reactor-type fuel rods, 2 fresh instrumented fuel rods, and 4 silver-indium-cadmium control rods, was surrounded by an insulating shroud and contained in a pressurized in-pile tube. The experiment consisted of a 1.3-h transient at a coolant pressure of 6.95 MPa in which the inlet coolant flow to the bundle was reduced to 0.6 g/s while the bundle fission power was gradually increased until dryout, heatup, cladding rupture, and oxidation occurred. With sustained fission power and heat from oxidation, temperatures continued to rise rapidly, resulting in zircaloy and control rod absorber alloy melting, fuel liquefaction, material relocation, and the release of hydrogen, aerosols, and fission products. The transient was terminated over a 2100-s time span by slowly reducing the reactor power and cooling the damaged bundle with argon gas. A description and evaluation of the major phenomena, based upon the response of on-line instrumentation, analysis of fission product and aerosol data, postirradiation examination of the fuel bundle, and calculations using the SCDAP/RELAP5 computer code, are presented. 40 refs., 160 figs., 31 tabs.

38444 (NUREG/CR–5187) **PRA [probabilistic risk assessment] applications program for inspection at Calvert Cliffs Unit 1 Nuclear Power Plant.** Vo, T.V.; Harris, M.S.; Gore, B.F. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Radiation Protection and Emergency Preparedness; Pacific Northwest Lab., Richland, WA (USA). Jun 1989. 112p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC06-76RL01830. (PNL–6574). Available from NTIS, PC A06/MF A01 - GPO - OSTI.

The level one probabilistic risk assessment (PRA) for Calvert Cliffs Unit 1 (CC-1) has been analyzed to identify plant systems and components important to minimizing public risk, as measured by system contributions to plant core melt frequency, and to identify the primary failure modes of these components. This information has been tabulated and correlated with inspection modules from the NRC Inspection and Enforcement Manual. The report presents a series of tables, organized by system and prioritized by risk importance, which identify components associated with 98% of the inspectable risk due to plant operation. The systems addressed, in descending order of risk importance, are: reactor protection, auxiliary feedwater, dc power, ac power, power conversion, high pressure injection, room cooling, salt water, safety relief valves, and chemical volume and control. This ranking is based on the Fussel-Vesely measure of risk importance, i.e., the fraction of the total core melt frequency which involves failures of the system of interest. 10 refs., 20 figs., 36 tabs.

38445 (NUREG/CR–5268) **Aging study of boiling water reactor residual heat removal system.** Lofaro, R.; Subudhi, M.; Gunter, W.; Shier, W.; Fullwood, R.; Taylor, J.H. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Brookhaven National Lab., Upton, NY (USA). Jun 1989. 201p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC02-76CH00016. (BNL-NUREG–52177). Available from NTIS, PC A10/MF A01 - GPO - OSTI.

A study of the aging effects on Residual Heat Removal (RHR) systems in Boiling Water Reactors (BWRs) was performed as part of the Nuclear Plant Aging Research (NPAR) program. The objectives of the NPAR program are to provide a technical basis for the identification and evaluation of degradation caused by age in nuclear power plant applications. The information from this and other NPAR studies will be used to assess the impact of aging on plant safety and to develop effective mitigation actions. The effects of aging in the RHR system were characterized using the Aging and Life Extension Assessment Program (ALEAP) Systems Level Plan developed by Brookhaven National Laboratory. Failure data from various national data bases were reviewed and analyzed to identify predominant failure modes, causes and mechanisms. Time-dependent failure frequencies for major components were calculated to identify aging trends. Plant specific information was also reviewed to supplement data base results. A computer program (PRAAGE-1988) was developed and implemented to model a typical RHR design and perform time-dependent Probabilistic Risk Assessment (PRA) calculations. Time-dependent failure probabilities were input to the PRAAGE program to evaluate the effects of aging on component importance and system unavailability. 21 refs., 63 figs., 26 tabs.

38446 (NUREG/CR–5371) **Development and use of risk-based inspection guides.** Taylor, J.H.; Fresco, A.; Higgins, J.; Usher, J.; Long, S.M. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Radiation Protection and Emergency Preparedness; Brookhaven National Lab., Upton, NY (USA). Jun 1989. 82p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC02-76CH00016. (BNL-NUREG–52199). Available from NTIS, PC A05/MF A01 - GPO - OSTI.

Risk-based system inspection guides, for nuclear power plants which have been subjected to a probabilistic risk assessment (PRA), have been developed to provide guidance to NRC inspectors in prioritizing their inspection activities. Systems are prioritized, and then dominant component failure modes and human errors within those systems are identified for the above-stated purposes. Examples of applications to specific types of NRC inspection activities are also presented. Thus, the report provides guidance for both the development and use of risk-based system inspection guides. Work is proceeding to develop a method methodology for risk-based guidance for nuclear power plants not subject to a PRA. 18 refs., 1 fig.

38447 (PNL-SA–16923) **Risk based NDI [nondestructive inspection] guidelines.** Simonen, F.A.; Vo, T.V.; Doctor, S.R. Pacific Northwest Lab., Richland, WA (USA). May 1989. 16p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC06-76RL01830. (CONF-8905178–1: 6. National Aeronautics and Space Administration nondestructive evaluation workshop, Houston, TX, USA, 23-26 May 1989). Order Number DE89014458/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Risk-based methods incorporating the consequences of failure of system components are a modern analytic approach being utilized to develop and set priorities for nondestructive inspection (NDI) plans such as location, extent, frequency, and required effectiveness of the periodic inservice inspections. This methodology relies on evaluating the probability of component failure based on flaw detection and characterization capabilities, service conditions, and historical failure experience. From this, an optimized NDI plan can be designed to help ensure that the failure (loss of function) probability for a given component is within an acceptable level. Applying this concept to an entire system or structure will result in a NDI plan that will maximize safety and readiness, while reducing costs by eliminating unnecessary examination of less critical components. After noting examples of existing applications, a discussion is given of how the methodology could be applied to the inservice inspection of an orbiting space station.

38448 (SAND–88-2214C) **Severe accident testing of a personnel airlock.** Clauss, D.B.; Parks, M.B.; Julien, J.T.; Peters, S.W. Sandia National Labs., Albuquerque, NM (USA). 1989. 7p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (CONF-890855–12: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA, USA, 14-18 Aug 1989). Order Number DE89010031/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Sandia National Laboratories (Sandia) is investigating the leakage potential of mechanical penetrations as part of a research program on containment integrity under severe accident loads for the US Nuclear Regulatory Commission (NRC). Barnes et al. (1984) and Shackelford et al. (1985) identified leakage from personnel airlocks as an important failure mode of containments subject to severe accident loads. However, these studies were based on relatively simple analysis methods. The complex structural interaction between the door, gasket, and bulkhead in personnel airlocks makes analytical evaluation of leakage difficult. In order to provide data to validate methods for evaluating the leakage potential, a full-size personnel airlock was subject to simulated severe accident loads consisting of pressure and temperature up to 300 psig and 800°F. The test was conducted at Chicago Bridge and Iron under contract to Sandia. Julien and Peters (1989) provide a detailed report on the test program. 6 refs., 5 figs.

38449 (SAND–88-2215C) **Investigation of seismic limit states for LWR containments.** Clauss, D.B.; von Riesemann, W.A.; Costello, J.F. Sandia National Labs., Albuquerque, NM (USA). 1989. 7p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (CONF-890855–5: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA, USA, 14-18 Aug 1989). Order Number DE89009328/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

An in-depth analytical study was conducted by Sargent and Lundy Engineers under contract to Sandia in order to determine typical values for seismic capacities and plausible seismic failure modes of LWR containments. This was a scoping study to determine if seismic events pose a significant threat to containment integrity. The seismic capacities of the containment buildings of four nuclear power plants located in the eastern United States were investigated for four different conditions of internal pressure and temperature. Sixteen potential limit states were postulated and structural calculations were conducted to identify the critical limit states for each containment. In this investigation, load combinations well beyond the original design basis were considered. The results are interpreted in the context of generic seismic hazard curves, which are subject to large uncertainty, especially for the strong ground motion corresponding to levels beyond the SSE. Therefore, careful exercise of engineering judgment is required to evaluate seismic threat. This paper provides only a very brief summary of the results and a Sandia/NRC perspective of seismic threat to containment integrity. 4 refs., 1 fig., 4 tabs.

38450 (SAND–88-7158C) **Integrated MELPROG/TRAC analyses of a PWR station blackout.** Heames, T.J.; Smith, R.C. Sandia National Labs., Albuquerque, NM (USA). 1989. 11p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (CONF-890819–10: ASME/AIChE national heat transfer conference, Philadelphia, PA (USA), 6-9 Aug 1989). Order Number DE89010434/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

A complete, coupled, mechanistic analysis of the entire reactor coolant system during a station blackout (TMLB') has been completed using MELPROG/TRAC. The analysis includes the loss of all coolant pump seals at 100 minutes into the accident; in all other respects the case is identical to a previous station-blackout analysis. Both cases were initiated at the start of the accident and followed through boiloff of the water, failure of the control and fuel rods, oxidation of the Zircaloy and the formation of U-Zr-O eutectics, failure of the vessel internal structures due to melting and loading, massive core disruption and subsequent vessel failure. The two cases reached significantly different end conditions. The basic TMLB' resulted in a high pressure (15 MPa) vessel failure approximately 4 hours after accident initiation. The addition of a 12.5 mm hole in each pump seal resulted in a significantly lower pressure (0.27 MPa) at vessel failure, almost 10 hours after accident initiation. Therefore, high pressure melt ejection (HPME) and subsequent direct containment heating (DCH) were predicted not to occur in the TMLB' accident scenario with pump seal failure. This significant difference in end conditions demonstrates the need for a detailed, as well as mechanistic, treatment of the important physical processes within the complete reactor coolant system. The calculation shows the capabilities of MELPROG when coupled to TRAC, and that the resulting tool gives the user the potential to correctly predict, and therefore manage, an accident by determining the final results of possible operator interventions. 9 refs., 9 figs., 2 tabs.

38451 (SAND–89-0384C) **An equation of state formulation for Hicks-Menzies FCI [fuel-coolant interaction] efficiencies.** Cline, D.D.; Pong, L.T.; Beck, D.F.; Berman, M. Sandia National Labs., Albuquerque, NM (USA). 1989. 7p. Sponsored by DOE Nuclear Energy. DOE Contract AC04-76DP00789. (CONF-890819–8: ASME/AIChE national heat transfer conference, Philadelphia, PA, USA, 6-9 Aug 1989). Order Number DE89009796/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Energetic fuel-coolant interactions may occur in a nuclear reactor in the event that molten fuel comes in contact with the reactor coolant water. Reliable mechanistic models of these interactions have yet to be developed and so relatively simple thermodynamic models have been proposed for estimating the conversion of thermal energy to mechanical work. The present paper outlines a generalized thermodynamic model for fuel-coolant interactions which accounts for variable thermodynamic properties as well as the effect of latent heat in the fuel. The variable property model is shown to provide an upper bound (most conservative) estimate of the conversion efficiency compared to other formulations appearing in the literature. 7 refs., 5 figs.

38452 (Stralenbescherming–39-G) **Financial-economical risk limit.** Jansen, H.M.A.; Instituut voor milieuvraagstukken-Ministeris VROM Collaboration. Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Directie Stralenbescherming. Dec 1988. 42p. (In Dutch). Order Number DE89631287/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Is also affected to TLNRRRN NL89C0447, NL89C0450.

This report makes part of a series of eight reports which have been drawn up in behalf of the dutch Policy Notition Radiation Standards (BNS). In this report the results are presented of an investigation into a financial-economic risk limit. An inventarization has been made of how the concept economical damage is used in various policy domains. It is investigated if therewith use has been made of a financial-economic risk limit. The height of this limit has been assessed. In order to give a checklist of the aspects which have to be taken into account in the calculation of the financial-economic damage, the character of the low probability-high consequence needs to be mentioned nearer. (author). 49 refs.; 4 figs.; 4 tabs.

38453 (UJV–8525-T) **Nuclear safety research: programs at IAEA, in US and France VTEI study.** Vymetal, L. Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia). Aug 1988. 22p. (In Czech). Order Number DE89631621/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A survey is presented of nuclear safety in the US and in France and of IAEA activities in this area. The two countries have been selected because the US ranks first in the world in the number of nuclear power plants and installed nuclear capacity (ca 1/3 of total world installed nuclear capacity) and France because of the proportion of electric power generated by nuclear power plants (70%) which ranks in the world first in this respect. It also ranks first in the dynamics of its nuclear program. The study only deals with civilian light water reactors and emphasis is put on the safety of the primary coolant circuit, mainly the reactor core. The four-part study discusses the content and aims of research. IAEA program and activities, safety research in the US and in France. Research of the external fuel cycle is not included. (author). 14 refs.

38454 (VROM–80282/6-88) **Report of the supplementary measuring program Chernobyl.** Vaas, L.H. (Coordinatie-Commissie voor de Metingen van Radioactiviteit en Xenobiotische Stoffen (CCRX), Rijswijk (Netherlands). Werkgroep Meettechnieken Radioactiviteit); Zoeteman, B.C.J. (Commissie Rapportage Aanvullend Meetprogramma Tsjernobyl, Den Haag Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Jun 1988. 127p. (In Dutch). Order Number DE89631286/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Includes list of acronyms.

In this report, which is a continuation of the report of the Dutch Coordination Commission for measurement of Radioactivity and Xenobiotic materials (CCRX) "Radioactive contamination in the Netherlands caused by the reactor accident in Chernobylsk" of October 1986, the results are discussed of the supplementary measuring programme, till October 1st 1987, and a survey is given of the state of affairs with regard to the execution of the recommendations from the first Chernobylsk report. (H.W.). 53 refs.; 28 figs.; 50 tabs.

38455 TMI-2 radiocesium behaviour. Lorenz, R.A. (Oak Ridge Nat. Lab., Oak Ridge, TN (US)); Campbell, D.O.; Malinauskas, A.P.; Collins, E.D.; Lowrie, R.S.; Culberson, O.L.; Collins, J.L. v.v of Proceedings of the American Nuclear Society meeting on fission-product behaviour and source term research. American Nuclear Society, La Grange Park, IL (1985). (CONF-8507160–: ANS meeting on fission product behaviour and source term research, Snowbird, UT, USA, 15-19 Jul 1985).

It is often assumed that the chemical form of fission product cesium after release from fuel in a severe LWR accident is a mixture of –90% CsOH and a –10% CsI. Release, transport, reaction, and postaccident leaching data from TMI-2 have been examined in an effort to establish the validity of this assumption. Gas-phase transport of cesium occurs as a combination of vapor and species forming or attached to liquid - or solid aerosol particles. Chemical reactions can occur with either structures or aerosols. Results of the analysis show behavior characteristics of the assumed initial chemical form of cesium.

38456 TREAT light water reactor source term experiments program. Herceg, J.E. (Argonne Nat. Lab., Argonne, IL (US)); Blomquist, C.A.; Chung, K.S.; Dunn, P.F.; Johnson, C.E.; Kraft, D.A.; Schlenger, B.J.; Shaftman, D.H.; Simms, R. v.v of Proceedings of the American Nuclear Society meeting on fission-product behaviour and source term research. American Nuclear Society, La Grange Park, IL (1985). (CONF-8507160–: ANS meeting on fission product behaviour and source term research, Snowbird, UT, USA, 15-19 Jul 1985).

Four experiments are being conducted in the TREAT facility to investigate the behaviour of fission products released from typical LWR fuel overheated to the point of catastrophic cladding degradation. Heatup and steam flow transients are used that simulate the conditions expected in operating power reactors undergoing various types of hypothetical severe accidents. The experiments are integral in nature and are aimed at the physicochemical characterization, near the point of origin, of the biologically important volatile fission products released early in such accidents. Detailed program objectives are discussed, a test matrix is presented, and the test apparatus is described. Pretest analysis and preliminary results are reported for the first test.

38457 Fission product behaviour during the first two PBF severe fuel damage tests. Osetek, D.J. (EG and G Idaho Inc., Idaho Falls, ID (US)); Cronenberg, A.W.; Hobbins, R.R.; Vinjamuri, K. v.v of Proceedings of the American Nuclear Society meeting on fission-product behaviour and source term research. American Nuclear Society, La Grange Park, IL (1985). (CONF-8507160–: ANS meeting on fission product behaviour and source term research, Snowbird, UT, USA, 15-19 Jul 1985).

The results of the first two severe fuel damage tests performed in the Power Burst Facility are assessed in terms of fission product release and chemical behavior. On-line gamma spectroscopy and grab-sample data indicate limited release during solid-phase fuel heatup. Analysis indicates that the fuel morphology conditions for the trace-irradiated fuel employed in these two tests limit initial release. Only upon high temperature fuel restructuring and liquefaction is significant release indicated. Chemical equilibrium predictions, based on steam oxidation or reduction conditions, indicate I to be the primary iodine species during transport in the steam environment of the first test and CsI to be the primary species during transport in the hydrogen environment of the second test. However, the higher steam flow rate conditions of the first test transported the release iodine through the sample system; whereas, low-hydrogen flow rate of the second test apparently allowed the vast majority of iodine-bearing compounds to plateout during transport.

38458 Characterization of solid debris transported in the coolant during the first two severe fuel damage tests. Vinjamuri, K. (EG and G Idaho Inc., Idaho Falls, ID (US)); Osetek, D.J.; Hobbins, R.R.; Doyle, T.E. v.v of Proceedings of the American Nuclear Society meeting on fission-product behaviour and source term research. American Nuclear Society, La Grange Park, IL (1985). (CONF-8507160–: ANS meeting on fission product behaviour and source term research, Snowbird, UT, USA, 15-19 Jul 1985).

This paper presents the results of the characterization of solid debris collected from the coolant during the Severe Fuel Damage Scoping Test and the Severe Fuel Damage Test 1-1 conducted by EG and G Idaho Inc., at the Idaho National Engineering Laboratory. A variety of analytical techniques were used to characterize the debris samples. Fission product release fractions and particle size distributions were measured, and the probable chemical forms in the debris were identified.

38459 Radionuclide deposition in the PBF steam vent line after the first two severe fuel damage tests. Akers, D.W. (EG and G Idaho Inc., Idaho Falls, ID (US)); Koeppen, L.D.; McIssac, C.V.; Simpson, O.D. v.v of Proceedings of the American Nuclear Society meeting on fission-product behaviour and source term research. American Nuclear Society, La Grange Park, IL (1985). (CONF-8507160–: ANS meeting on fission product behaviour and source term research, Snowbird, UT, USA, 15-19 Jul 1985).

Following the first two PBF Severe Fuel Damage Tests, measurable quantities of fission products remained irreversibly deposited (i.e. to water flushes) on the inside surface of the effluent steam line. The gamma spectral measurements of these deposits are presented with an analysis that describes the quantities of distribution of fission products associated with the deposits. The deposition profile along the steam line of various fission-product isotopes is presented.

38460 RAFT - A computer model for formation and transport of fission product aerosols in LWR primary systems. Im, K.H. (Argonne Nat. Lab., Argonne, IL (US)); Ahluwalia, R.K.; Chuang, C.F. v.v of Proceedings of the American Nuclear Society meeting on fission-product behaviour and source term research. American Nuclear Society, La Grange Park, IL (1985). (CONF-8507160–: ANS meeting on fission product behaviour and source term research, Snowbird, UT, USA, 15-19 Jul 1985).

A computer model RAFT (Reactor Aerosol Formation and Transport) has been developed to predict the size distribution and composition of the particles (aerosols) formed from condensation of the fission-product and control rod material vapors released in LWR accidents. The underlying theory of RAFT considers the processes of homogeneous and heterogeneous nucleation, aerosol agglomeration, and aerosol and vapor deposition, in conjunction with the equilibrium chemistry of the Cs-I-Te-O-H-Ag-In-Cd-inert gas system. Calculations using RAFT show that under most accident conditions, the particle size spectrum is determined primarily by the competition between the homogeneous and heterogeneous nucleation mechanisms rather than the agglomeration mechanism, and that direct vapor deposition on structural surfaces is an important mechanism for the scavenging of fission product vapours.

38461 Particle retention in PWR ice compartments. Owczarski, P.C. (Pacific Northwest Labs., Richland, WA (US)). v.v of Proceedings of the American Nuclear Society meeting on fission-product behaviour and source term research. American Nuclear Society, La Grange Park, IL (1985). (CONF-8507160–: ANS meeting on fission product behaviour and source term research, Snowbird, UT, USA, 15-19 Jul 1985).

Computer code ICEDF has been written to improve understanding of particle retention in PWR ice compartments, and to help plan experimental tests to validate retention models. ICEDF models the following mechanisms for particle capture: sedimentation, Brownian diffusion, impaction/interception, thermophoresis, diffusiophoresis, and turbulent deposition. Also modeled are detailed gas phase thermodynamics, heat transfer, and aerosol descriptions, including particle/droplet growth in supersaturated atmospheres. This paper describes a sensitivity study of parameters (inlet particle size distribution and mass loading, inlet gas temperature and steam fraction, compartment parameters, ice availability and gas flow rates) on the relative importance of the particle capture mechanisms.

38462 Chemical reactions of CsOH, CsI and Te vapours with oxidizing reactor materials. Sallach, R.A. (Sandia Nat. Labs., Albuquerque, NM (US)); Elrick, R.M. v.v of Proceedings of the American Nuclear Society meeting on fission-product behaviour and source term research. American Nuclear Society, La Grange Park, IL (1985). (CONF-8507160–: ANS meeting on fission product behaviour and source term research, Snowbird, UT, USA, 15-19 Jul 1985).

The status of the High Temperature Fission Product Chemistry Program at Sandia is reviewed, major findings are: the interaction of CsOH vapor with 304 stainless steel in steam results in retention of cesium in the inner oxide layer. Microprobe analyses show a strong correlation between Cs and Si and indicate the formation of $Cs_2Si_4O_9$; when CsI vapor is contacted with this alloy in steam there is little retention of Cs; the interaction of Te vapor in steam with Inconel-600 at 800^{0}C results in retention of Te. With 304 SS no Te was detected on the oxide surface of T>800^{0}C; at 700^{0}C there was retention of Te. Microprobe analyses indicate the formation of a nickel telluride on both alloys; thermodynamic calculations indicate the reaction of CsOH vapor but not CsI vapor with boric acid vapors. Release of iodine, observed experimentally, may result from reaction of CSI vapor with molten B_2O_3.

25 ENERGY STORAGE

2501 Magnetic

Refer also to citation(s) 39756

2506 Thermal

Refer also to citation(s) 38348, 38732

38463 (CONF-890815–1) **Development of encapsulated lithium hydride thermal energy storage.** Olszewski, M.; Siman-Tov, M. Oak Ridge National Lab., TN (USA). 1989. 15p. Sponsored by DOD;DOE/ER. DOE Contract AC05-84OR21400. From 24. intersociety energy conversion engineering conference; Washington, DC, USA; 7-12 Aug 1989. Order Number DE89010169/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A packaged bed thermal storage unit using encapsulated LiH spheres has been proposed as a means of reducing the mass and size of space-based heat rejection systems in applications with pulsed power needs. The initial value analysis indicated that the thermal energy storage (TES) system could be beneficial. Preliminary assessment of the concept identified several feasibility issues and indicated that the encapsulating shell must be relatively thin (0.127 mm) for the concept to be attractive. The major area of technical uncertainty is associated with shell stresses during heating when the expanding material (LiH density changes by about 27% between the solid and liquid state) at the shell surface is trapped between the encapsulating shell and the solid LiH core. Preliminary experimental results indicated that shell rupture does not occur because cracks formed in the LiH during cooling allow the liquid to communicate with a central void volume. This paper presents an overview of the recent analytical and experimental work performed to demonstrate the feasibility of the encapsulated LiH concept. 7 refs., 8 figs.

2509 Batteries

Refer also to citation(s) 38842

38464 (DOE/CE/15257–T4) **Battery thermal management unit: Final report.** Sanders, N.A. Sanders (Nicholas A.). Norwich, VT (USA). 1989. 99p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG01-86CE15257. Order Number DE89007963/JAW. Available from NTIS, PC A05/MF A01 - OSTI.

A battery warming device has been designed which uses waste heat from an operating internal combustion engine to warm a battery. A portion of the waste heat is stored in the sensible and latent heat of a phase change type material for use in maintaining the battery temperature after the engine is shut off. The basic design of the device consists of a Phase Change Material (PCM) reservoir and a simple heat exchanger connected to the engineer's cooling system. Two types of units were built, tested and field trialed. A "strap-on" type which was strapped to the side of an automotive battery and was intended for the automotive after-market and a "tray" type on which a battery or batteries sat. This unit was intended for the heavy duty truck market. It was determined that both types of units increased the average cranking power of the batteries they were applied to. Although there were several design problems with the units such as the need for an automatic thermostatically controlled bypass valve, the overall feeling is that there is a market opportunity for both the strap-on and tray type battery warming units. 38 refs., 26 figs., 6 tabs.

38465 (SAND–88-3375C) **A nickel/hydrogen battery for solar applications.** Bush, D.M.; Sindorf, J.F. Sandia National Labs., Albuquerque, NM (USA). 1989. 7p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. (CONF-890815–2: 24. intersociety energy conversion engineering conference, Washington, DC, USA, 7-12 Aug 1989). Order Number DE89011513/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The nickel/hydrogen battery was developed in the early nineteen-seventies as an energy storage subsystem for commercial communication satellites in geosynchronous orbits. It has since qualified for low-earth orbit applications and it is an option for electrochemical storage on the Space Station. The advantages offered by nickel/hydrogen batteries include long calendar life, increased cycle life, low maintenance, and high reliability. It is recognized that these battery attributes would make it very useful for similar applications on earth, such as stand-alone photovoltaic systems. The major drawback to the wider use of the nickel/hydrogen battery is its high initial

cost. Under the sponsorship of the United States Department of Energy, Sandia National Laboratories (SNL) established and has directed cost-shared programs over the last several years to address developmental and cost reduction issues concerned with implementing a terrestrial version of the nickel/hydrogen battery. The primary objective of these programs is to reduce the cost of the battery to the point where it would be competitive with the lead-acid battery on a life-cycle cost basis, without unduly compromising its performance. 3 refs.

38466 Pattern recognition and cluster analysis studies of fabrication and initial test data for lead-acid peak shaving batteries. Perone, S.P. (Chemistry and Materials Science Dept., Lawrence Livermore Lab., Livermore, CA (US)); Spindler, W.C. v.v of Proceedings of the Electrochemical Society Fall meeting: Extended abstracts. Volume 87-2. The Electrochemical Society, Pennington, NJ (1987). (CONF-871027–: 172. meeting of the Electrochemical Society, Honolulu, HI, USA, 18-23 Oct 1987).

Previous studies have demonstrated feasibility of applying computerized pattern recognition to battery lifetime prediction. The present study began with the production of 340 large motive power lead-acid cells, where the authors provided guidance for documenting the factory fabrication procedures and initial test repertoire. This provided a data base containing information most suitable for lifetime prediction, based on the most useful features identified from earlier studies. Compared to the earlier work, however, cell lifetime data are not available to provide a training set for supervised pattern recognition. Thus, unsupervised pattern recognition methods were required, to identify naturally-occurring sub-sets of lead-acid cells from initial measured properties. The physical significance of these sub-sets could be inferred from known characteristics, from cycle-test performance data, and ultimately from lifetime data. Predictive guidelines based on results with other related training sets for analogous features could also be investigated.

29 ENERGY PLANNING AND POLICY

38467 (DOE/EIA–0173(80)/1) **1980 annual report to Congress: Volume one, Activities.** USDOE Energy Information Administration, Washington, DC (USA). 1980. 80p. Sponsored by DOE Management & Administration. Order Number DE89015008/JAW. Available from NTIS, PC A05/MF A01 - GPO - OSTI; GPO Dep.

The Energy Information Administration is the primary government agency for collecting, analyzing, and publishing statistics. This volume of EIA's Annual Report to Congress provides a description of its activities in 1980, as well as its plans for 1981. Chapters 1 through 5 outline activities and plans of EIA's five program offices: Energy Data Operations, Energy Systems and Support, Energy Information Validation, Program Development, and Applied Analysis. Chapters 6 and 7 describe the work of EIA's three support offices: Energy Information Services; Planning, Evaluation, and Project Control; and Management Services. Pertinent information on EIA organization, publications, data collection systems, and models can be found in the volume's appendixes.

38468 (DOE/EIA–0173(80)/2) **1980 annual report to congress: Volume two: Data.** USDOE Energy Information Administration, Washington, DC (USA). 13 Apr 1981. 263p. Sponsored by DOE Management & Administration. Order Number DE89014982/JAW. Available from NTIS, PC A12/MF A01 - GPO - OSTI; GPO Dep.

This annual report to congress contains energy related information including: energy consumption; exports and imports; petroleum and natural gas resources exploration and development; petroleum supplies; natural gas supplies; coal supplies; electricity; nuclear power; solar energy; geothermal energy; and other energy related topics. (JEF)

38469 (DOE/EIA–0173(81)SYN) **1981 annual report to Congress synopsis: Energy statistics and projections.** USDOE Energy Information Administration, Washington, DC (USA). Aug 1982. 52p. Sponsored by DOE Management & Administration. Order Number DE89015007/JAW. Available from NTIS, PC A04/MF A01 - GPO - OSTI; GPO Dep.

The Energy Information Administration produces an Annual Report to Congress of which we are most proud. Much more than just a conventional report on the agency's activities and products, our Annual Report also describes the Nation's energy picture from our statistical and analytical points of view. It provides 30 years' worth of historical data on energy reserves, resources, supply disposition, stocks, and prices, and extends its scope in to the future as well, presenting analyses of likely energy-related trends and developments in the years ahead. That broad scope is clearly reflected in the actual size of the Annual Report — the entire three-volume 1981 edition is comprised of about 450 pages. This Synopsis provides the reader with historical information and projections selected from the 1981 Annual Report and published in a form designed for ready reference. We hope you find it convenient and useful.

38470 (DOE/IR/05106–T93) **Development of an energy action plan: A participatory approach.** Elsass, D.; Ford, J.M.; Miller, R.D. Urban Consortium for Technology Initiatives (USA). Energy Task Force. Feb 1983. 91p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013858/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Hennepin County government and its residents have much to gain by an effective response to issues of energy cost and availability, but–as many other areas of the country–are severely limited in their ability to respond. The purpose of this project was to develop an energy management strategy for the community. The Energy Action Plan provides a realistic direction for Hennepin County. The Plan's methodology may be useful to other local governments concerned about addressing energy problems within the current fiscal and political environment. Chapter 2 of this report provides a general background for the project, including a description of Hennepin County and the economic and political environment in which the project was conducted. Project objectives and structure are also presented. Chapter 3 describes the processes used in the development of the Energy Action Plan. Conclusions and expected future plans are also described. Chapter 4 summarizes the significant lessons learned during the project and presents recommendations to others contemplating similar projects.

2901 Energy Analysis and Modeling

38471 (DOE/EIA–0173(SYN)) **Synopsis of energy facts and projections.** USDOE Energy Information Administration, Washington, DC (USA). 1978. 59p. Sponsored by DOE Management & Administration. Order Number DE89015087/JAW. Available from NTIS, PC A04/MF A01 - GPO - OSTI; GPO Dep.

This book is meant to provide a quick reference to domestic and international energy data and projections for which the Energy Information Administration (EIA) receives frequent requests. Energy facts and forecasts in this Synopsis present information on energy supply, demand, prices, and resource availability drawn from Volumes Two and Three of the Energy Information Administration's Annual Report to Congress, 1978.

38472 (DOE/EIA–0203/1) **Recent products of applied analysis, July 1979–October 1979: Issue No. 1.** Cleggett, P. USDOE Energy Information Administration, Washington, DC (USA). Assistant Administrator for Applied Analysis. Oct 1979. 17p. Sponsored by DOE Management & Administration. Order Number DE89014989/JAW. Available from NTIS, PC A03/MF A01 - GPO - OSTI; GPO Dep.

This is the first "Recent Products of Applied Analysis." The Office of Applied Analysis is within the Energy Information Administration, US Department of Energy. One of its responsibilities is to promote a better understanding of the Nation's energy situation. In a continuing effort to meet that challenge, we provide you with this listing. It compiles abstracts of Applied Analysis reports published since June 1979. This listing will be published four times a year.

38473 (DOE/EIA–0276) **Guidelines and procedures for the conduct of a review of data requirements.** Smith, C.S. USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Information Validation. Mar 1981. 36p. Sponsored by DOE

Management & Administration. Order Number DE89015004/JAW. Available from NTIS, PC A03/MF A01 - GPO - OSTI; GPO Dep.

A review of the requirements is an examination of primary information sources for an energy subject area, or primary uses and requirements for data from these sources, and of the rationale for determining to what degree each requirement should be satisfied by the Energy Information Administration (EIA). This paper is divided into three sections: Section I, the introduction, gives a brief overview of the institutional and intellectual context in which the Office of Energy Information Validation (OEIV) conducts reviews of requirements; Section II is a step-by-step description of key elements in the conduct of a review of requirements; and Section III is a guide to presentation of the results of a review of requirements. 7 refs., 2 figs.

38474 (DOE/EIA–0281) **Energy transitions: The forecasts through 2020: Issue paper.** Hutzler, M.J.; Reynolds, A.W.; Cornett, C.M. USDOE Energy Information Administration, Washington, DC (USA). Mar 1981. 28p. Sponsored by DOE Management & Administration. Order Number DE89015013/JAW. Available from NTIS, PC A03/MF A01 - GPO - OSTI; GPO Dep.

This paper presents the forecasts of energy supply and demand through 2020 made by the Energy Information Administration (EIA) for the Annual Report to Congress, 1980. These projections offer one alternative strategy for the future energy transition from scarce oil and gas to other resources. Following a discussion of the assumptions and results of the base case projections is an examination of the sensitivity of the forecast to key parameters. The EIA energy future is then compared with four other studies, highlighting differences in emphasis placed in various technologies and energy sources. 4 figs., 8 tabs.

38475 (DOE/EIA–0386) **Evaluation of the International Energy Evaluation System (IEES): Validation report.** Choi, D.Y. USDOE Energy Information Administration, Washington, DC (USA). Office of Statistical Standards. Feb 1983. 111p. Sponsored by DOE Management & Administration. Order Number DE89014999/JAW. Available from NTIS, PC A06/MF A01 - GPO - OSTI; GPO Dep.

This report presents the results of the International Energy Evaluation System (IEES) model evaluation undertaken by the Quality Assurance Division, Office of Statistical Standards (OSS), Energy Information Administration (EIA). The IEES model has been used extensively as a major analytical tool by the International Energy Branch to forecast the global equilibrium demand, supply and prices of energy materials for 1985, 1990 and 1995, and to analyze various global energy policy implications. 20 refs.

38476 (DOE/EIA–0465) **EIA publications manual: Statistical graphs.** USDOE Energy Information Administration, Washington, DC (USA). Office of Statistical Standards. Apr 1985. 67p. Sponsored by DOE Management & Administration. Order Number DE89015745/JAW. Available from NTIS, PC A04/MF A01 - GPO - OSTI; GPO Dep.

Statistical graphs both illustrate a set of data and provide an analytical perspective. The distinction between these two functions is one of emphasis. Where the purpose of a graph is to dramatize or highlight a set of data, its primary function is illustration. Where the purpose of a graph is to explore, measure, calculate, and derive relationships, the primary function of the graph is analytical. In general practice, these two functions can be so interdependent as to be indistinguishable. The following guidelines are intended to aid in resolving problems common to the presentation of data in statistical graphs. The variety and complexity of data to be presented call for a flexible approach; therefore, the following examples are intended not as inflexible specifications but rather as guides to the design of graphs that are attractive and easily understood. All the types of graphs discussed here have appeared in EIA publications. A list of references that provides further examples is included. Also included is a glossary of statistical terms used in discussing the statistical properties of different types of graphs. 11 refs., 24 figs.

38477 (DOE/EIA–0475) **Demand analysis system elasticities.** Cohen, B.N.; Holte, J.A.; Werbos, P.J. USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Markets and End Use. Jun 1985. 68p. Sponsored by DOE Management & Administration. Order Number DE89014978/JAW. Available from NTIS, PC A04/MF A01 - GPO - OSTI; GPO Dep.

The Demand Analysis System (DAS) provides energy consumption projections for the residential, commercial, industrial, and transportation sectors to 1995. These projections are developed within an integrated supply/demand balance framework known as the Intermediate Future Forecasting System (IFFS). Each of the end-use sectors is represented by a detailed structural econometric model within IFFS. These models are fully described in documentation reports, and only a summary discussion of each is provided in Appendix B of this report. The purpose of this report is to summarize the behavior of DAS with respect to changes in energy prices and income. Aggregate as well as fuel and end-use sector energy demands are considered. The version of DAS used in developing the Annual Energy Outlook 1984 (AEO) is the basis for all discussion and analysis in this report. This report prepared in response to many requests for an accessible overview of the mechanics of how The Energy Information Administration's (EIA's) energy demand forecasts were developed. It is not a documentation report. It does not attempt to justify by statistical or other means the various equations, parameters, and assumptions used to develop the energy demand forecasts. Such justification and documentation is available, however, for each of the end-use sector elements of DAS. 17 refs., 16 figs., 34 tabs.

2902 Economics and Sociology

Refer also to citation(s) 37834, 38090, 38483, 38513, 38514, 38520, 38523, 38526, 38661, 38695, 38696, 38723, 38725, 38930, 38964

38478 (DOE/EIA–0374) **Analysis of the validity of the coefficient estimates and forecasting properties of the RDFOR [Regional Demand FORcasting] models: A summary report: Validation report.** Kuh, E.; Lahiri, S.; Minkoff, A.; Swartz, S.; Welsch, R. USDOE Energy Information Administration, Washington, DC (USA). Office of Statistical Standards; Massachusetts Inst. of Tech., Cambridge, MA (USA). Center for Computational Research in Economics and Management Science. Nov 1982. 121p. Sponsored by DOE Management & Administration. DOE Contract AM01-76EI02295. Order Number DE89014998/JAW. Available from NTIS, PC A06/MF A01 - GPO - OSTI; GPO Dep.

The Regional Demand FORcasting model (RDFOR) is a simple econometric model currently used by the DOE within the Midterm Energy Forecasting System. Econometric models are often used to provide baseline forecasts of near- to mid-term economic behavior. From the point of view of the policymaker, it is desirable to ascertain as objectively as possible the degree to which these econometric forecasts can be trusted. This paper illustrates, within the context of the industrial and residential sectors of RDFOR, a number of diagnostic tools of general interest which are useful in assessing model reliability.

38479 (DOE/EIA–0519) **Energy severance taxes, 1972-1987.** USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Markets and End Use. Aug 1988. 22p. Sponsored by DOE Management & Administration. Order Number DE89014980/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Energy severance taxes are a major source of revenue for State governments. They also affect investment by energy companies and play an important role in determining the location and profitability of energy production. Despite this importance, published time series for energy severance taxes relative to prices and production are virtually nonexistent for the country as a whole and across States. This paper presents such series on a consistent basis for the first time and explains the causes for the changes that have occurred since 1972. Separate data are presented for crude oil and natural gas and for coal. Unless otherwise indicated all data are on a fiscal year basis consistent with the fiscal years of the States. 5 tabs.

38480 (DOE/IR/05106–T123) **The hidden link: Energy and economic development: Phase 1, strategic planning: A guidebook for local government.** Zelinski, R.W.; Rooney, D. Urban Consortium for Technology Initiatives (USA). Energy Task Force. Apr

1987. 92p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89015432/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This guidebook is organized in four major chapters. Chapter 1 examines the linkages between energy management and economic development on national and local levels. It discusses the multiplier effect of energy conservation and the effects of energy costs on the residential, commercial, and industrial sectors. A discussion of other insidious effects of energy costs, such as building abandonment, is also included. Chapter 2 contains an adapted strategic planning process to use in the linkage of energy management and community/economic development. Six steps including (1) building a consensus and working team; (2) conducting the environmental scan; (3) selecting key linkages; (4) conducting an internal analysis and identifying resources; (5) developing goals, objectives, and strategies; and (6) developing an action plan and implementation steps. Many of the steps are illustrated with case studies. Chapter 3 presents a preliminary analysis of public/private financing options matched with the energy projects of the six participating local governments. A description and discussion of applicability is included for each financing option. Chapter 4 contains a description of each participating jurisdiction's project, how each used a strategic planning step and examined public/private financing options, and a few notes on the technical assistance provided during the course of the project. 10 figs.

38481 (DOE/PE–0090) **Energy's role in international trade: Structural changes and competitiveness.** USDOE Office of Policy, Planning and Analysis, Washington, DC (USA). Jul 1989. 34p. Sponsored by DOE Management & Administration. Order Number DE89013916/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The role of energy in the competitive position of US goods in foreign trade is the topic of this study. It is obvious that energy is important in US trade because we import and export energy commodities. It is less obvious, but true, that energy plays an indirect role in trade because the energy embodied in traded goods is an element of their costs. The objective of this report is to identify how important energy is in the production of domestic goods, the role of energy in US trade, and how energy use and the structure of the economy have changed over time. Subsequent reports in this study will examine the role of energy in US trade with other countries. This first report was motivated by four objectives: understand the changes in the structure of the US economy that result from higher energy prices and other economic shocks, assess the effects of these structural changes on US energy use, present a research design that will allow a better understanding of the role that energy plays in the competitiveness of US goods in world trade, and explain how macroeconomic and microeconomic factors can affect structural change in the economy, and how energy is linked to these factors. 34 refs., 4 tabs., 11 figs.

38482 (NEI-DK–172, pp. 35-72) **Decentral dual-purpose power plants. Caught between pricing regulations in relation to electric power consumption and energy duties.** Lund, H. (Institut for Produktion og Institut for Samfundsudvikling og Planlaegning, Aalborg Universitetscenter (DK)); Maeng, H.; Hvelplund, F. Teknologiraadets Styregruppe for Vedvarende Energi, Copenhagen (Denmark). 1987. (In Danish). (CONF-8710469–: Conference on decentral dual-purpose power plants, Moltkes Palae (Denmark), 26 Oct 1987). In *Decentral dual-purpose power plants.* Order Number DE89776141/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

Detailed suggestions for a renewal of legislation on taxes and prices in relation economical feasibility of elctric power production from decentral dual-purpose power plants in Denmark. (AB) 16 refs.

2903 Environment, Health, and Safety

Refer also to citation(s) 38211, 38212, 38213, 38214, 38215, 38216, 38217, 38218, 38219, 38220, 38221, 38222, 38223, 38224, 38250, 38251, 38252, 38253, 38484, 38488, 38489, 38490, 38493, 38522, 38560, 38562, 38739, 39175, 39260, 39348

38483 (CONF-890705–1) **Misplaced liability, insurance unavailability, and counterproductive environmental policy: A case study of the scrap metal industry.** Katzman, M.T. Oak Ridge National Lab., TN (USA). 1989. 19p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From 8. international zeolite conference; Amsterdam, Netherlands; 10-14 Jul 1989. Order Number DE89014091/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The scrap processing industry recycles metals like steel, aluminum, and lead from discarded consumer products. Although this industry serves the purposes of energy and environmental policy, about one third of its members have been held liable for cleanup under the American Superfund law. The insurance industry has promulgated widely varying estimates of the costs and consequences of this law, but few facts have been adduced. A unique survey of over 500 scrap recyclers indicates the magnitude of the cleanup costs, transactions cost of litigation, and the resultant loss-prevention and loss-protection responses. The empirical loss distribution provides a basis for calculating the pure premium that might be charged by a risk-retention group and identifies reasonable bases of exposure classification. 7 refs., 6 tabs.

2904 Natural Resources

38484 (PB–89-162861/XAB) **Government policies and deforestation in Brazil's Amazon region.** Mahar, D.J. International Bank for Reconstruction and Development, Washington, DC (USA). 1989. 64p. Available from NTISMF A01.

Microfiche copies only. Paper copy available from World Bank, 1818 H St., NW, Washington, DC 20433.

Contents include: Brazil's Amazonian Forests (biological diversity, the magnitude and rate of deforestation, proximate causes of deforestation); and the evolution of regional policies (operation Amazonia, the Belem-Brasilia Highway, incentives for livestock development, the National Integration Program, the Cuiaba-Porto Velho Highway and Polonoroeste, the era of big projects).

2905 Research, Development, Demonstration, and Commercialization

Refer also to citation(s) 38035, 38049, 38530, 38744, 38770, 38964

38485 (CANWEC–1989, pp. 105-108) **Industrial innovation through electrotechnologies.** Gilsig, T. (Hydro-Quebec). Canadian National Committee, World Energy Conference, Ottawa, ON (Canada). [1989]. (CONF-8811238–: 11. Canadian national energy forum, Calgary, Canada, 21-22 Nov 1988;CE–02686). In *Energy in Canada. The potential, the markets and the money.* Available from Canadian National Committee World Energy Conference, Suite 305, 130 Albert Street, Ottawa, Ont., Canada K1P 5G4; $30.00 CAN.

Electrotechnologies are industrial processes which use electricity and represent an important element in any strategy of industrial innovation because of their wide range of applications and the benefits which they can bring to industrial processes though reduced energy use and greater controllability as compared with conventional sources of energy. This paper discussed world energy trends and the shift from conventional sources to electrification in Europe and Canada, and the factors which are driving the shift. A description of those industries leading this shift is also included.

38486 (DOE/EIA–0149(87)) **EIA publications directory 1987: A user's guide.** National Energy Information Center, Washington, DC (USA). 30 Mar 1988. 126p. Sponsored by DOE Management & Administration. Order Number DE89015127/JAW. Available from NTIS, PC A06/MF A01 - GPO - OSTI; GPO Dep.

Since October 1977, the Energy Information Administration (EIA) of the Department of Energy has been responsible for collecting and publishing statistical data on energy production, consumption, prices, resources, and projections of supply and demand. EIA Publications Directory: A User's Guide provides access to EIA publications. The Publications Directory, published by the National Energy Information Center, is used by Federal agencies, State and Local governments, libraries, energy-related organizations and the general public. This issue contains abstracts of publications released by EIA for printing in 1987. The Publications Directory lists

all 1987 EIA publication by subject, title, and report number. It also explains how to order these publications. The abstracts of the publications are arranged by broad subject categories such as coal, petroleum, natural gas, and energy planning and policy. These categories are further divided. For example, the petroleum category is divided into reserves, drilling and production, processing petroleum products, and marketing and economics.

2906 Nuclear Energy

Refer also to citation(s) 38353, 38383

38487 (EDF-DER-RA–1988-1) **DER 88. Main facts.** Anon. Electricite de France, 75 - Paris (France). 1989. 135p. (In French). Order Number DE89781450/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

This report presents the important facts among the studies carried out by the Direction des Etudes et Recherches (EDF/DER): new applications of electric power for customers, protection of environment, classical equipments for power plants and nuclear equipments, monitoring and control of power plants, electrical equipments, development and operation of electrical networks, informatics and office automation.

38488 (GAO/RCED–87-122) **Nuclear regulation.** General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. 1988. 14p. Available from US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

GAO found that no federal agency assesses public knowledge of radiological emergency procedures. The Federal Emergency Management Agency has responsibility for ensuring the adequacy of offsite emergency plants at nuclear power plants and has periodically conducted surveys to determine whether emergency planning zones residents have received basic emergency planning information. However, FEMA has not assessed whether the public actually knows what to do in the event of an emergency. GAO believes it is appropriate that FEMA do this. This report provides information concerning the actions that utilities and FEMA take to notify EPZ residents of the procedures to be followed if a nuclear accident occurs. It recommends that FEMA develop a survey to assess EPZ residents' knowledge of radiological emergency procedures.

38489 (GAO/RCED–87-124) **Nuclear regulation.** General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. 1988. 48p. Available from General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Price-Anderson Act encourages private industry development of nuclear energy. It establishes a source of funds to compensate personal injury and property damage from a nuclear accident and limits the liability of private industry for such accidents. The indemnity provisions of the act, which allow the Nuclear Regulatory Commission and the Department of Energy to enter into new indemnity agreements and set the liability limits, expire in August 1987. GAO believes that the act's indemnity authority should be extended and that its liability protection is too low to provide reasonable compensation for the worst nuclear plant accident. The financial consequences of a catastrophic accident at 115 of 119 plants could far exceed the liability limit. The act covers all off-site accident damages resulting from the release of radioactive material. However, it does not clearly state whether the costs for a precautionary evacuation are covered when a release appears imminent but does not actually occur.

38490 (GAO/RCED–88-137) **Nuclear health and safety.** General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. 1988. 13p. Available from US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

Problems remain in the Department of Energy's environment, safety, and health program which, if unaddressed, may keep the program from functioning effectively. Specifically, GAO found that the health and safety functions of the program are not legislatively mandated. As a result, the current or future Secretary of Energy could relegate these issues to a level within DOE which may not provide top management attention. DOE's Advisory Committee on Nuclear Facility Safety is not structurally distinct and separate from DOE and does not have the authority to require DOE to address it findings and recommendations. DOE also has not fully determined what commercial safety standards are applicable to its nuclear facilities and therefore cannot demonstrate if they are comparably safe to the commercial facilities. Without defining these standards, no clear criteria exist for determining what aspects of the facilities need to be upgraded or replaced.

38491 (Stralenbescherming–39-F) **Possible affection of psychic health with regard to exposure to ionizing radiation.** Otten, W.; Vlek, C.A.J.; Rijksuniversiteit Groningen-Ministerie VROM Collaboration. Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Directie Stralenbescherming. Dec 1988. 78p. (In Dutch). Order Number DE89631604/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

Is also affected to TRN NL89C0443-NL89CO446, NL89C0449, NL89C0450.

This report makes part of a series of eight reports which have been drawn up in behalf of the dutch Policy Notition Radiation Standards (BNS). It presents the results of an investigation into the possible affection of psychic health with regard to exposure to ionizing radiation. First the concept 'psychic health' is circumscribed. Subsequently the possible effects of ionizing radiation upon psychic health are entered by outlining two cause-effect chains, in which various variables are distinguished. Thus the framework in which the remainder of the report has been written, is described (ch.2). Ch. 3 deals with the measurability of psychic health and of the various variables in two cause-effect chains. In ch. 4 the found empirical evidence of the effects of ionizing radiation upon psychic health is described. This chapter is especially based upon study of literature. In ch. 5 interviews with users of various radiation sources are reported. In ch. 6 the question of standardization of ionizing radiation with regard to possible (psychic) damage is entered. It is looked if one can speak in terms of 'standards' in case of psychic damage. As far as standardization does not seem to be possible practical alternatives are presented with which eventual psychic damage from ionizing (radiation) sources may be limited. Finally in ch. 7 a comparison is made between the theoretical framework of the (possible) effects of ionizing radiation upon psychic health and the measurability of the therein distinguishable variables on the one hand, and, on the other hand, the empirical materials obtained from the study of the literature and the interviews. (H.W.) 103 refs.; 8 figs.

38492 (VROM–80495/12-88) **Information about radiation. Evaluation of a mass-medial campaign.** Midden, C.J.H.; Daamen, D.D.L.; Lans, I.A. van der; Verplanken, B.; Min. VROM-State Univ. Leiden Collaboration. Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). 1988. 100p. (In Dutch). Available from Library KNAW, P.O. Box 41950, 1009 DD Amsterdam, Netherlands.

This report contains the results of an evaluation study in which the Dutch information campaign on Radiation and the effects of this campaign have been analysed in detail. The problem is stated. The investigation model, the evaluation method and the random tests used are discussed. The interview lists and measurements are elucidated. The information-diffusion process is evaluated (how well the information reaches the purpose group). The effects of the campaign upon the knowledge level about radiation, upon the attitudes towards radiation from different sources and upon the attitudes towards storage of radioactive wastes and application of nuclear power, are discussed. Factors are analysed which have influenced the character and extent of campaign effects, such as, for example, the credibility of the information source and the participation of the population with the subject. (H.W.). refs.; figs.; tabs.

38493 **Managing the Department of Energy's hazardous and mixed defense wastes.** Sharples, F.E. (Office of Defense Waste and Transportation Management, Dept. of Energy (US)); McBrayer, J.F. v.v of Proceedings of the fourth annual hazardous materials management conference. Tower Conf. Management Company, Wheaton, IL (1986). (CONF-860695–: HazMat '86: hazardous materials management conference and exhibition, Atlantic City, NJ, USA, 2-4 Jun 1986).

The Department of Energy (DOE) has overall responsibility for the production of nuclear weapons and nuclear materials, and the

Assistant Secretary for Defense Programs (ASDP) is the cognizant Departmental official for the weapons programs. The mission of the Office of the ASDSP is to provide and maintain a nuclear weapons complex with sufficient capacity and capability to assure a prudent level of flexibility in national security options. To fulfill its mission, Defense Programs (DP) operates 16 production, processing, testing, and research and development (R and D) installations in 13 states. The production of nuclear weapons is a large-scale industry, and like other industries, it generates wastes. Defense activities result in wastes that are either radioactive or chemically hazardous or both. Many of the waste streams (e.g., halogenated solvents contaminated with uranium) are not common in private industry and require special handling and procedures to protect health and the environment. In addition, national security requires that DOE maintain strict safeguards on defense-related materials and information. These security needs indicate that the Department maintain a coordinated and uniform program despite considerable variation in waste management regulations from location to location. This paper provides an overview of DOE's defense waste management and describes the program that has been developed for managing hazardous and mixed wastes.

2910 Conservation

Refer also to citation(s) 38480, 38481, 38538, 38540, 38542, 38543, 38544, 38545, 38546, 38547, 38548, 38549, 38550, 38551, 38552, 38553, 38554, 38555, 38556, 38557, 38559, 38561, 38571, 38572, 38585, 38589, 38590, 38594, 38595, 38596, 38598, 38599, 38600, 38601, 38602, 38603, 38604, 38605, 38606, 38607, 38608, 38613, 38614, 38620, 38621, 38622, 38625, 38627, 38628, 38629, 38630, 38631, 38633, 38634, 38635, 38636, 38656, 38657, 38695, 38709, 38725

38494 (DOE/IR/05106–T101) **Developing sources and techniques for alternative financing of energy conservation projects for local government.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Apr 1985. 96p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013866/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Identifying financing sources to pay for energy conservation projects is the greatest potential obstacle to implementing energy conservation measures in private and public sector facilities. Local jurisdictions that want to take advantage of energy conservation opportunities often do not have the in-house expertise to determine which financing techniques are available or how to evaluate and pursue those that exist. This research project was designed to provide some potential guidelines which could be used by local jurisdictions in identifying various financing mechanisms and determining which financing mechanisms best fit a given type of energy conservation project. 1 fig., 2 tabs.

38495 (DOE/IR/05106–T104) **Reducing regulatory and financial impediments to energy conservation: A project report.** Baker, P.S. Urban Consortium for Technology Initiatives (USA). Energy Task Force. Jul 1983. 112p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013869/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The research objective of this project was to consolidate as much information as possible about building codes, regulations, and standards and demonstrate how this information could be used to remove impediments to constructing energy efficient buildings and to provide incentives. This project will serve as a guide for other cities to improve and develop codes, standards, and regulations which encourage energy efficiency in construction. 120 refs., 11 figs.

38496 (EPRI-CU–6367-Vol.2 A.3) **Wood heat displacement: effects on planning and residential conservation and marketing programs.** Brandis, P. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC UTILITIES/load management; RESIDENTIAL BUILDINGS/energy conservation; WOOD/uses; ELECTRIC POWER; MARKETING; SPACE HEATING; WOOD; USES

38497 (EPRI-CU–6367-Vol.2 A.17) **End-use metering of commercial buildings.** Martinez, M.; Alereza, T.; Mort, D. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

COMMERCIAL BUILDINGS/power demand; ELECTRIC POWER/metering; ELECTRIC UTILITIES/load management; METERING; METERS

38498 (EPRI-CU–6367-Vol.2 A.23) **Characterizing residential space conditioning loads.** Ruderman, H.; Wood, D.J. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC UTILITIES/load management; RESIDENTIAL BUILDINGS/air conditioning; SPACE HVAC SYSTEMS/energy consumption; ELECTRIC POWER

38499 (EPRI-CU–6367-Vol.2, pp. 46.1-46.8) **Comparison study of energy savings methodologies.** Ecker, L.; Parti, M.; Dion M. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Central Maine Power Company uses both two-stage PRISM (PRInceton Scorekeeping Method) and Conditional Demand analyses to determine energy savings attributable to its energy management programs. A comparison study is presented of the results of a two-stage PRISM analysis using annual data with the results of a one-stage conditional demand analysis using monthly data. These results are then compared with the initial engineering estimates used for Central Maine Power Company's Bundle-Up program for electric water heating customers. The study uses data from a sample of participants in the Bundle-Up Program Data from participant surveys, installation records, billing records, and Company load research were used in the analysis of electricity savings attributable to the program. The program offered the following five measures: R-10 insulation wrap, temperature setting turndown, low-flow shower head, two faucet aerators, and sediment removal. The preliminary engineering estimates indicated an annual electricity savings of 1,077 kilowatt-hours if all the measures are installed. Both methodologies used in this comparison study indicate savings of significantly fewer kilowatt hours than the original engineering estimates.

38500 (EPRI-CU–6367-Vol.2, pp. 47.1-47.13) **Comparison of two utility conservation incentives for commercial and industrial customers.** Hicks, E.G. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

New England Electric System (NEES) currently offers two types of incentive programs to encourage its largest commercial and industrial customers to invest in conservation and load management. The first program is a demand-side bidding experiment where

NEES purchases conservation and load management from energy services companies (ESCOs) on a price per kW basis. This program is called the Performance Contracting Program. The second program is a Custom Rebate Program, where NEES will pay an incentive of up to $500/kW for any conservation or load management investment the customer wishes to make. NEES and the Company's earlier experiences in demand-side bidding are described. A comparison of the two programs to date is presented.

38501 (EPRI-CU–6367-Vol.2, pp. 48.1-48.14) **Demand-side management programs for new residential and commercial buildings: what have we learned.** Vine, E.L.; Harris, J.P. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

In a report prepared for the US Department of Energy's least-cost utility planning program, market penetration analysis was clearly the most often mentioned research challenge in the least-cost planning area. The approach taken in investigating the issue of market penetration is evaluating the experience of demand-side management (DSM) programs implementing these technologies. Instead of relying on theoretical models of market penetration, the study relied on the experience of those people that were implementing DSM programs in the field.

38502 (EPRI-CU–6367-Vol.2, pp. 49.1-49.15) **Building an integrated resource planning process from a traditional supply planning function: the Montana-Dakota experience.** Huss, W.R.; Paulsen, G. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Montana-Dakota Utilities Co. (MDU) is a combination gas and electric utility with an electric service territory covering the eastern portion of Montana, the western and south central portion of North Dakota, and the north central portion of South Dakota. With approximately 110,000 electric customers, MDU has a summer peak demand of approximately 360 MW and a winter demand slightly lower. Thirty percent of its electric load is residential and approximately 30% is commercial. The remaining 40% consists primarily of coal mining, oil field pumping, and small industrial. In October 1987, MDU responding in part to an order from the North Dakota Public Utilities Commission, engaged XENERGY Inc. to serve as prime contractor for the development of a comprehensive integrated resource planning (IRP) project. MDU's objectives were to: facilitate a coordinated process for exchanging data between load forecasting, marketing, regulatory affairs, accounting, data processing, and finance; produce a reliable end-use load forecast; evaluate demand- and supply-side options on an equal basis; improve customer information; promote consistency with corporate objectives and regulatory requirements; and develop at least three scenarios of future business along with corresponding integrated resource plans. The results of the program are discussed.

38503 (EPRI-CU–6367-Vol.2, pp. 54.1-54.12) **Market research: a tool to increase customer acceptance of energy management programs.** Goldfarb, L.K. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Both Company strategy and state policy have moved conservation and energy management to the forefront of energy planning at Central Maine Power Company (CMP). Since 1983, annual spending on these programs has risen more than fifty-fold - from $180,000 to $10,000,000. Staff have been reinforced, and programs developed and refined, to produce impressive savings in energy and capacity. Market research has become a key element in shaping CMP's conservation and energy management efforts over the last four years. Following a total reorganization of the conservation and energy management efforts in 1985 and the creation of a fully integrated marketing department to spearhead these efforts, a market research analyst experienced in consumer product research was hired. CMP's efforts to increase customer acceptance of energy management programs are described.

38504 (EPRI-CU–6367-Vol.2, pp. 57.1-57.10) **New house: an evaluation of a utility-sponsored new home program.** Gage, J.B.; Niewald, J.W. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Surrogate data are frequently used in planning and developing demand-side management (DSM) programs. Engineering calculations are commonly used in estimating peak demand reductions and on-peak and off-peak additions. While estimates are appropriate and important for the development, planning, and implementation of DSM programs, load metering is an essential element in the proper evaluation of such programs. Southwestern Public Service Company recently completed a metering project to determine the true impact of its Energy Efficient Homes Program. The results revealed the energy efficient homes are significantly more efficient than the standard new home. In addition, the metered results showed that the energy efficient homes are much more efficient than was indicated by the initial engineering estimates.

38505 (EPRI-CU–6367-Vol.2 A.19-A.20) **Evaluation of the enforcement costs of the Washington State commercial energy code.** O'Neill, M.L.; Johnson, M. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

COMMERCIAL BUILDINGS/energy conservation; ELECTRIC UTILITIES/load management; BUILDING CODES; COST; ELECTRIC POWER; ENFORCEMENT; EVALUATION

38506 (EPRI-CU–6367-Vol.2 A.21-A.22) **Metered residential hot water loads in the Pacific Northwest - implications for demand side management programs.** Ross, B.A.; Pratt, R.G. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC UTILITIES/load management; RESIDENTIAL BUILDINGS/hot water; WATER HEATERS/energy consumption; ELECTRIC POWER

38507 (EPRI-CU–6367-Vol.2 A.5-A.6) **Case study: integrated use of energy management technologies and programs at a major ski resort.** Cutter, M.R. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC UTILITIES/load management; RECREATIONAL AREAS/energy conservation; ENERGY MANAGEMENT; OPERATION

38508 (EPRI-CU-6367-Vol.2 A.53-A.55) **Preliminary evaluation of computer modeling forecasts of energy consumption in energy edge building.** Anderson, K.J.; Stucky, L.D. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

COMMERCIAL BUILDINGS/energy conservation; ELECTRIC UTILITIES/load management; COMPUTER-AIDED DESIGN; ELECTRIC POWER

38509 (EPRI-CU-6367-Vol.2 A.7-A.8) **Water heater cycling - the modern approach.** Estey, D.P. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC UTILITIES/load management; WATER HEATERS/energy conservation; COST; OPERATION

38510 (NEI-DK-172, pp. 27-33) **Development of decentral heat and power generation. Based on the present situation in Germany and Holland.** Maegaard, P. Teknologiraadets Styregruppe for Vedvarende Energi, Copenhagen (Denmark). 1987. (In Danish). (CONF-8710469–: Conference on decentral dual-purpose power plants, Moltkes Palae (Denmark), 26 Oct 1987). In *Decentral dual-purpose power plants.* Order Number DE89776141/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

With regard to the development of decentral power generation, it is postulated that Germany and Holland are currently in a strong leading position in relation to other countries, yet Denmark is well advanced in its development of the utilization of renewable energy. Examples are given of decentral dual-purpose power plants in Germany and Holland, and these are compared with initiatives and plans current in Denmark together with suggestions for further development. (AB).

38511 (ORNL/FTR-3298) **[Participate in in-depth discussions with the Federal Republic of Germany concerning possible membership in the International Energy Agency's Center for the Analysis and Dissemination of Demonstrated Energy Technologies, Bonn, W. Germany, June 15, 1989]: Foreign trip report.** Brown, M.A. Oak Ridge National Lab., TN (USA). 26 Jun 1989. 5p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE89014872/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler, as Executive Secretary of the United States Center for the Analysis and Dissemination of Demonstrated Energy Technologies (CADDET) National Team, was part of a delegation of four individuals which briefed German Federal Ministry for Research and Technology (BMFT) officials on CADDET. The purpose of the presentation was to provide BMFT officials with the details on the CADDET operation, and to thereby encourage Federal Republic of Germany (FRG) membership in the Center. CADDET currently has 11 member countries, two more than when it was created in 1988. To be an effective and viable operation, CADDET needs to expand its membership; FRG participation would be particularly valuable.

2920 Supply, Demand, and Forecasting

Refer also to citation(s) 38000, 38285, 38471, 38481, 38485, 38525, 38528, 38568

38512 (DOE/EIA-0173(80)/3SUM) **1980 annual report to Congress: Volume three, Forecasts: Summary.** USDOE Energy Information Administration, Washington, DC (USA). 27 May 1981. 48p. Sponsored by DOE Management & Administration. Order Number DE89015012/JAW. Available from NTIS, PC A04/MF A01 - GPO - OSTI; GPO Dep.

This report presents an overview of forecasts of domestic energy consumption, production, and prices for the year 1990. These results are selected from more detailed projections prepared and published in Volume 3 of the Energy Information Administration 1980 Annual Report to Congress. This report focuses specifically upon the 1980's and concentrates upon similarities and differences in the domestic energy system, as forecast, compared to the national experience in the years immediately following the 1973–1974 oil embargo. Interest in the 1980's stems not only from its immediacy in time, but also from its importance as a time in which certain adjustments to higher energy prices are expected to take place. The forecasts presented do not attempt to account for all of this wide range of potentially important forces that could conceivably alter the energy situation. Instead, the projections are based on a particular set of assumptions that seems reasonable in light of what is currently known. 9 figs., 25 tabs.

2930 Policy, Legislation, and Regulation

Refer also to citation(s) 38001, 38031, 38107, 38234, 38244, 38245, 38352, 38488, 38489, 38516, 38517, 38523, 38524, 38525, 38526

38513 (CANWEC–1989, pp. 19-21) **Saskatchewan's energy policy framework and outlook.** Reid, J.F. (Dept. of Energy and Mines, Sk, Canada). Canadian National Committee, World Energy Conference, Ottawa, ON (Canada). [1989]. (CONF-8811238–: 11. Canadian national energy forum, Calgary, Canada, 21-22 Nov 1988;CE–02686). In *Energy in Canada. The potential, the markets and the money.* Available from Canadian National Committee World Energy Conference, Suite 305, 130 Albert Street, Ottawa, Ont., Canada K1P 5G4; $30.00 CAN.

Saskatchewan's energy resources include oil and natural gas, hydro potential, coal and uranium. This paper presents an overview of each of these, including the resources, reserves, market, and government policies, as well as their relationship to the environment.

38514 (CANWEC–1989, pp. 22-24) **Alberta's energypotential and policies.** MacMurchy, N.E. (Dept. of Energy, AB, Canada). Canadian National Committee, World Energy Conference, Ottawa, ON (Canada). [1989]. (CONF-8811238–: 11. Canadian national energy forum, Calgary, Canada, 21-22 Nov 1988;CE–02686). In *Energy in Canada. The potential, the markets and the money.* Available from Canadian National Committee World Energy Conference, Suite 305, 130 Albert Street, Ottawa, Ont., Canada K1P 5G4; $30.00 CAN.

This paper presents a brief review of Alberta's production and reserves of conventional oil, synthetic crude oil, and sulfur. The paper then outlines government policies for the development of these resources, concluding with the identification of 2 major trends related to energy development: the increasing efficiency of industrialized economies, and the increasing awareness of environmental impact of energy development and consumption. Also included is the response of the government of Alberta to these trends.

38515 (CANWEC–1989, pp. 25-27) **British Columbia energy potential and policies.** Hoswill, D.H. (Dept. of Energy, Mines and Petroleum Resources, BC, Canada). Canadian National Committee, World Energy Conference, Ottawa, ON (Canada). [1989]. (CONF-8811238–: 11. Canadian national energy forum, Calgary, Canada, 21-22 Nov 1988;CE–02686). In *Energy in Canada. The potential, the markets and the money.* Available from Canadian National Committee World Energy Conference, Suite 305, 130 Albert Street, Ottawa, Ont., Canada K1P 5G4; $30.00 CAN.

British Columbia is a net exporter of electricity, natural gas, natural gas liquids, and coal, and is an importer of crude oil products. This paper outlines natural gas policies, including the core market policy, the Vancouver Island natural gas pipeline, B.C. Gas Inc., and B.C. Petroleum Corporation; electricity export policy; offshore petroleum resources; and coal resources and markets. An overview of policy initiatives relating to environmental protection and the use of waste resource products is also included.

2940 Fossil Fuels

Refer also to citation(s) 37834, 37940, 37985, 38000, 38001, 38031, 38037, 38048, 38088, 38090, 38094, 38107, 38534, 38639

38516 (CHOA–8812, pp. 12) **The government's role in heavy oil development. Notes for remarks.** Scarborough, R.M. Canadian Heavy Oil Association (Canada). 1988. (CONF-881295–: Conference on heavy oil markets in the 90s: how do they look?, Calgary, Canada, 1 Dec 1988;CE–02646). In *Heavy oil markets in the 90s. How do they look?*. Available from Canada Oil and Gas Lands Administration, 355 River Rd., 15th Floor, Tower B, Ottawa, ON, Canada K1A 0E4; $N/C.

This paper presents the industry's views on the relationship between government and development and operation of the oil industry, particularly in relation to the developent of heavy oil. After a short description of the climate of the 60s and 70s, four factors are identified as contributing to the pace of development. Of these, taxation and royalties are concerned with governments and these, taxation and royalties are concerned with governments and these are described. It is suggested that the federal and provincial levels of government re-evaluate the impact of their net split of industry generated revenues. The paper addresses environmental concerns as well.

38517 (CHOA–8812, pp. 8) **The government role in heavy oil development.** Reid, J. (Saskatchewan Energy and Mines, SK, Canada). Canadian Heavy Oil Association (Canada). 1988. (CONF-881295–: Conference on heavy oil markets in the 90s: how do they look?, Calgary, Canada, 1 Dec 1988;CE–02646). In *Heavy oil markets in the 90s. How do they look?*. Available from Canada Oil and Gas Lands Administration, 355 River Rd., 15th Floor, Tower B, Ottawa, ON, Canada K1A 0E4; $N/C.

This paper presents an overview of the province of Saskatchewan's assistance in the development of heavy oil. The paper begins with a short introduction on current production and its value with the technical and economic constraints. A description is given of the various mechanisms used, mainly in the provincial field but also federally, concluding with a summary of the key roles of government in promoting heavy oil development.

38518 (CHOA–8812, pp. 19) **Upgrading. How much and how far.** Horwood, B. (Shell Canada ltd.). Canadian Heavy Oil Association (Canada). 1988. (CONF-881295–: Conference on heavy oil markets in the 90s: how do they look?, Calgary, Canada, 1 Dec 1988;CE–02646). In *Heavy oil markets in the 90s. How do they look?*. Available from Canada Oil and Gas Lands Administration, 355 River Rd., 15th Floor, Tower B, Ottawa, ON, Canada K1A 0E4; $N/C.

With the significant increases in heavy oil and bitumen production capacity forecasted for future years, markets for incremental production will become more remote and competitive, netbacks will decrease, and the incentive to consider upgrading to synthetic crude oil will increase. This paper discusses the economic and strategic issues around the question of investing in upgrading capacity in Western Canada, concluding that such upgrading is an investment opportunity in the longer term. Strategic consideraions strongly indicate that initiatives would be put n place in the shorter term, with government(s) having a key role in support.

38519 (DOE/EIA–0137/1) **Preliminary report of natural gas deliveries and curtailments to end-use customers, 1978–1979 heating season (November–March): Energy data report.** USDOE Energy Information Administration, Washington, DC (USA). 3 Oct 1978. 16p. Sponsored by DOE Management & Administration. Order Number DE89014985/JAW. Available from NTIS, PC A03/MF A01 - GPO - OSTI.

These data are the preliminary results of a survey tabulated by the Energy Information Administration of over 1500 gas companies that supply natural gas to end-use customers. Information presented are actual data for the 1977–1978 heating season (November through March) and projected data for the 1978–1979 heating season as compiled from gas company responses reported on Form EIA-50. Projected data have been reported by respondent gas companies based on the assumption of normal winter demands in their market areas. Actual data for deliveries represent metered volumes of natural gas and supplemental gaseous fuels such as SNG, LNG, and propane-air delivered by gas companies to end-use customers. Excluded from deliveries are volumes of gas sold for resale. Curtailments represent volumetric reductions from contract quantities, reductions from normal historical quantities, or reductions from other bases the reporting firm may select. Totals of firm and interruptible types of service may not equal totals for customer reporting. Table totals may not add due to rounding. All volumes are at 14.73 PSIA. Preliminary data published in this report are not expected to vary significantly from the final tabulation of this survey. 1 fig., 9 tabs.

38520 (DOE/EIA–0283) **A review of requirements for petroleum imports information.** USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Information Validation. Mar 1981. 400p. Sponsored by DOE Management & Administration. Order Number DE89015006/JAW. Available from NTIS, PC A18/MF A01 - GPO - OSTI; GPO Dep.

This review of requirements for petroleum imports information was prepared by the Office of Energy Information Validation (OEIV), Energy Information Administration (EIA), Department of Energy (DOE). This review includes: a full description of the petroleum import process; an analysis of legislation, regulation, Presidential proclamations and treaties affecting information needs; an analysis of the information needs of the primary DOE users and other knowledgeable analysts; a set of data elements and their characteristics that best serve general recurring information needs; an analysis of existing subject area and data collection instruments to determine current system adequacy in meeting user needs; recommendations for existing and developmental systems to improve data collections. The report identifies five distinct phases of importation that are of interest to DOE users: Contract, Loading, In-transit, Landing and Disposition. Specific needs and considerations of each phase are addressed individually. 13 tabs.

38521 (DOE/EIA–0410) **Evaluation of energy information administration form EIA-23 annual survey of domestic oil and gas reserves: Report years 1978–1979.** Kass, R.; Wakefield, G.H. USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. Jul 1983. 200p. Sponsored by DOE Management & Administration. Order Number DE89015030/JAW. Available from NTIS, PC A09/MF A01 - GPO - OSTI; GPO Dep.

This study by the Office of Oil and Gas (OOG), of the Energy Information Administration (EIA), concerns the quality of data gathered on crude oil and natural gas reserves and production for 1978 and 1979. By reporting on its field validation activities, OOG seeks to provide comprehensive information to interested analysts. A summary of background information on OOG's mandate to collect annual oil and gas production and reserves data, as well as the objectives of the validation effort, is provided in Chapter 1. In Chapter 2, a description of the Form EIA-23 "Annual Survey of Domestic Crude Oil and Gas Reserves" data collection system is provided. Chapter 3 describes the types of error that can be introduced in the data systems, Chapter 4 relates the difficulty respondents encounter with Form EIA-23, and Chapter 5 quantifies the differences between respondent filings on Form EIA-23 and the results of the validation team's independent analyses.

38522 (GAO/RCED–88-104) **Offshore oil and gas.** General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. 1988. 88p. Available from General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

About $450 million has been spent since 1973 to produce environmental studies of the outer continental shelf in support of the Department of the Interior's oil and gas lease sale decisions. Concerns have been raised about the program, particularly the usefulness and quality of the studies. Interior's Mineral Management Service uses the studies for OCS decision-making and in general was satisfied with their usefulness, timeliness, and quality. Some groups, however, believe that about half the studies were received too late to be used. Alaska program resources funding and the number of studies contracts, coupled with duplication of program administrative functions have reduced program efficiency. Consolidating these functions could save up to $1.3 million per year.

38523 (GAO/RCED–88-152) **Energy management.** General Accounting Office, Washington, DC (USA). Resources, Community

and Economic Development Div. 1988. 46p. Available from General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

Since 1986 states have received over $3 billion as a result of the Exxon and Stripper Well oil overcharge cases decided in the courts. The settlements resulted from actions the Department of Energy initiated to resolve alleged violations by crude oil producers of pricing regulations that were in effect between 1973 and 1981. The planned use of funds in seven states that GAO reviewed appeared to fall within allowable programs and be aimed at providing restitution to injured parties through energy conservation or energy assistance. DOE established new procedures for monitoring energy grant programs that place primary reliance on the states for carrying out on-site monitoring activities but it is too soon to determine whether they will be sufficient to ensure that states use Exxon and Stripper Well funds as the courts intended. GAO believes that DOE's procedures for monitoring Stripper Well funds used for non-grant projects, which provide for no on-site monitoring by DOE, are inconsistent with legislatively prescribed requirements.

38524 (GAO/RCED–88-161) **Surface mining.** General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. 1988. 16p. Available from General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Department of the Interior currently regulates surface mining. Should this function be transferred to another federal agency, the cost would probably range between $2 million and $3.3 million with program disruption for about 2 or more years. The Environmental Protection Agency seems to be the most logical agency to carry out the surface mining regulatory function if it were moved from Interior but determining whether this relocation would improve regulation is difficult.

38525 (GAO/RCED–88-175FS) **Oil reserves.** General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. 1988. 25p. Available from General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

As of March 1988, the Strategic Petroleum Reserve inventory totaled 544.9 million barrels of oil. During the past 6 months the Department of Energy added 11.0 million barrels of crude oil to the SPR. During this period, DOE distributed $208 million from the SPR Petroleum Account. All of the oil was purchased from PEMEX–the Mexican national oil company. In FY 1988, $164 million was appropriated for facilities development and management and $439 million for oil purchases. For FY 1989, DOE proposes to obligate $173 million for facilities development and management and $236 million for oil purchases. DOE plans to postpone all further drawdown exercises involving crude oil movements until their effects on cavern integrity are evaluated. DOE and the Military Sealift Command have made progress in resolving the questions surrounding nearly $500,000 in payments for demurrage charges.

38526 (GAO/RCED–88-198) **Naval Petroleum Reserve No. 1.** General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. 1988. 31p. Available from General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

The Department of the Navy originally managed four naval petroleum reserves but in October 1977, responsibility for managing the reserves was transferred from Navy to the Department of Energy. This report (1) discusses the legal authority for proposed sales of any of the four NPRS and (2) describes the chronology of events leading to and following each proposed sale, including the rationale for each sale and the result of each proposal, with concentration on NPR-1. In addition, the report includes a discussion of proposals to produce and sell NPR-1's oil and gas production for nonmilitary use. GAO believes that DOE has not adequately justified the sale of NPR-1. More information is needed, including information on the amount of oil reserves and on NPR-1's value to the government through continued ownership and operation.

2960 Electric Power

Refer also to citation(s) 38485, 38487, 38496, 38497, 38498, 38499, 38500, 38501, 38502, 38503, 38504, 38505, 38506, 38507, 38508, 38509, 38510, 38640, 38641, 38697

38527 (ANL/EES-TM–373) **The emerging market for independently produced power.** Sutherland, R.J. Argonne National Lab., IL (USA). Energy and Environmental Systems Div. Mar 1989. 54p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract W-31109-ENG-38. Order Number DE89014417/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

In the emerging market for independent power production, generating plants are being built and owned by independent investors and the capacity and energy are being sold to electric utilities under long-term contracts. This report focuses on the economic efficiency of the market and particularly on the allocation of various risks. The emerging market contains some economic inefficiencies. First, long-term contracts introduce transactions costs and possibly disequilibrium prices. Second, capital cost risks are not borne by independent power producers, but are shifted to consumers. Third, incentives are distorted against emerging technologies. Fourth, long-term contracts may lock one party into a commitment that may prove uneconomical, with the costs perhaps being shifted to consumers. Despite its limitations, the emerging market introduces an important element of competitiveness into the provision of generating capacity, and it offers the potential for development of a truly competitive market in the future. 34 refs., 6 figs.

38528 (CANWEC–1989, pp. 99-102) **Electric power development in Alberta and British Columbia.** Best, W.A. Canadian National Committee, World Energy Conference, Ottawa, ON (Canada). [1989]. (CONF-8811238–: 11. Canadian national energy forum, Calgary, Canada, 21-22 Nov 1988;CE–02686). In *Energy in Canada. The potential, the markets and the money.* Available from Canadian National Committee World Energy Conference, Suite 305, 130 Albert Street, Ottawa, Ont., Canada K1P 5G4; $30.00 CAN.

This paper examines electric power development potential and options in Alberta and British Columbia. An overview of the electric resources of each province is followed by domestic electric load forecasts over the next decade and a brief review of electric export market potential. The current electric system generation plan for each province over the next 10 years is reviewed, as well as the potential for achieving benefits through coordinated operation and development of the Alberta and British Columbia systems. Finally, transmission capabilities in Alberta, British Columbia and the western United States are briefly reviewed. Systems coordination appears to be a very attractive option for both Alberta and British Columbia. 2 figs., 3 tabs.

38529 (CANWEC–1989, pp. 103-104) **Electric generation, transmission, and markets in Saskatchewan and Manitoba.** Zaleski, E.A. (Manitoba Hydro, MB, Canada). Canadian National Committee, World Energy Conference, Ottawa, ON (Canada). [1989]. (CONF-8811238–: 11. Canadian national energy forum, Calgary, Canada, 21-22 Nov 1988;CE–02686). In *Energy in Canada. The potential, the markets and the money.* Available from Canadian National Committee World Energy Conference, Suite 305, 130 Albert Street, Ottawa, Ont., Canada K1P 5G4; $30.00 CAN.

Interconnections with neighboring utilities are important to the Saskatchewan and Manitoba power systems. This paper discusses the inter-utility transactions in place now, those planned or contemplated for the future, and the economics of future hydro exports to the U.S. The prospects of future Canadian hydro exports to the United States from Manitoba appear bright. If the gas-fuelled additions are made in the U.S., interruptible exports will be even more attractive than they are now, resulting in higher rates for the energy. Seasonal diversity exchanges with summer peaking U.S. utilities are expected to continue, although Manitoba will continue to rely on imports during droughts. Future firm exports appear to be economic.

38530 (DOE/CE/90142–T1) **Issues in electric energy systems: A review of the DOE R and D program: [Final report].** National Research Council, Washington, DC (USA). Committee on Electric Energy Systems. 1986. 75p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC01-84CE90142. Order Number DE89015477/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

To put the Electric Energy Systems (EES) program into perspective, this report begins with an in-depth review of the historic federal role in energy research and development. This review supports the

Committee's opinion that the federal support of research and development (R and D) in this area is warranted by a combination of federal policy and private-sector considerations (chapter 1). The report then examines the major categories of R and D requirements related to electric power systems: systems technology; reliability; and safety, health, and environment (chapters 2, 3, and 4). These chapters establish the need for specific research topics recommended by the Committee and also provide a critique of the current EES program plan. In the final chapter the Committee presents its critique of the EES history and current operations. It then provides summary views of the program management requirements and the general budget to carry out the Committee's recommendations. 44 refs.

38531 (DOE/EIA–0002) **National electric rate book: New Jersey: Energy data reports: Rate schedules for electric service in communities of 2500 population or more, residential, commercial, and industrial services.** USDOE Energy Information Administration, Washington, DC (USA). Sep 1977. 9p. Sponsored by DOE Management & Administration. Order Number DE89014975/JAW. Available from NTIS, PC A03/MF A01 - GPO - OSTI.

The National Electric Rate Book presents summaries of rate schedules under which electric service is sold to general ultimate consumers by all privately and publicity owned electric utilities operating in urban areas throughout the United States. The rates and the more important schedule provisions have been edited, abridged and rearranged by the staff of the Department of Energy from the rate schedules filed by the electric utilities and companies whose rates are shown. The texts of the rate schedule summaries have been submitted to the respective utilities for verification or revision prior to publication and in most cases have been certified as approved condensed versions of the rate schedules to which they refer. New State Sections are issued periodically to report new rate schedules and rate changes.

38532 (DOE/EIA–0373) **An evaluation of the national utility financial statement (NUFS) model: Validation report.** Hill, L.J.; Goldstein, M.; Alsmiller, R.G. Jr.; Toney, B. Oak Ridge National Lab., TN (USA). Dec 1982. 243p. Sponsored by DOE Management & Administration. DOE Contract AC05-84OR21400. Order Number DE89014974/JAW. Available from NTIS, PC A11/MF A01 - GPO - OSTI.

The analysis presented herein represents an assessment of the National Utility Financial Statement (NUFS) model, a financing regulatory model of the US electric utilities industry. As presently constituted, NUFS "assesses" the financial feasibility of the electric utilities' capacity expansion program emanating for the Mid-Term Energy Forecasting Systems (MEFS) through specification of a series of financial accounting relationships that result in the forecast of primary financial statements and other financial information. Since the MEFS code is a forecasting tool that is presently used to project energy-related magnitudes up to 1995, NUFS forecasts financial information in that same time horizon. The approach to the assessment of NUFS was based on a two-stage level of analysis. First, the individual equations in the code were analyzed in terms of their representation of the underlying institutional character of the electric utility regulatory environment. Second, the over-all performance of NUFS was assessed. 28 refs.

38533 (DOE/EIA–M038) **Model methodology and data description of the Electricity Market Module: Volume 1, Overview.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 30 Jun 1989. 39p. Sponsored by DOE Management & Administration. Order Number DE89015158/JAW. Available from NTIS, PC A03/MF A01 - GPO - OSTI.

The Electricity Market Module (EMM) projects prices and demands for electricity and determines fuel consumption for the production of electricity. The EMM is a component of the Intermediate Future Forecasting System (IFFS), which is designed to provide projections for energy markets in the context of an economic equilibrium. The EMM is a process model designed to simulate the behavior of electric utilities. It takes fuel prices and the initial demands as inputs from other components of IFFS and estimates the decisions utilities would make in utilizing and adding equipment to meet demand and minimize costs. Projections can be made on an annual basis through 2010. 12 refs., 3 figs.

38534 (DOE/IR/05106–T116) **Electric utility franchise guide.** Urban Consortium for Technology Initiatives (USA). Energy Task Force; Houston, City of, TX (USA). Jan 1988. 50p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89015425/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Through franchise agreements, municipalities grant energy providers the use of public easements for the transmission of electricity and natural gas from power sources to consumers. Generally, access to the public rights-of-way is generated in exchange for the payment to the City of a percentage of the gross revenues of the utility. This Guide presents a Model Electric Utility Franchise Agreement, structured by the city of Houston, to address cost-saving and revenue-enhancing issues that should be considered by any municipality in both the day-to-day administration of existing franchises, and at the time of franchise renewal and renegotiation. In addition to the model agreement this Guide includes Explanatory Comments that provide the basis and rationale for certain sections of the agreement as well as a Summary of Major Elements of franchise agreements in over sixty US municipalities.

38535 (DOE/PE–0089) **Least-cost utility planning issues: Uncertainty and indicators of implementation.** USDOE Assistant Secretary for Policy, Planning and Analysis, Washington, DC (USA). Office of Policy Integration; USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Office of Buildings and Community Systems. [1989]. 19p. Sponsored by DOE Conservation & Renewable Energy. Order Number DE89013915/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In the context of future electricity capacity and the use of electricity conservation to help meet future demand, the purpose of this report is to determine: whether limitations to the implementation of DSM programs can be attributed to utility perceptions of the uncertainties and unreliability of these activities, and whether these uncertainties are greater than those on the supply end of the utility system; and where conservation activities can be expected to be implemented, given certain indicators related to DSM and LCUP. 14 refs., 9 figs., 2 tabs.

38536 (EPRI-CU–6367-Vol.2 A.41) **Optimal peak load pricing, Hopkinson tariffs, and modified Hopkinson tariffs: a comparative analysis.** Becker, K.G. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC POWER/peak-load pricing; ELECTRIC UTILITIES/load management; REGULATIONS

38537 (EPRI-CU–6367-Vol.2 A.49) **Free riders in demand-side programs – how big a problem?.** Schoengold, D. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC UTILITIES/load management; COST BENEFIT ANALYSIS; ELECTRIC POWER; FINANCIAL INCENTIVES

38538 (EPRI-CU–6367-Vol.2 A.57) **Impact of energy codes on utility system uncertainty.** Bull, M.; Ford, A. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In

Demand-side management strategies for the 90s. Proceedings, Volume 2. Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

BUILDINGS/energy conservation; ELECTRIC UTILITIES/load management; BUILDINGS; COST; ELECTRIC POWER

38539 (EPRI-CU-6367-Vol.2 A.69) **Evaluation of time-of-use rate program performance.** Bevc, V. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510--Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC POWER/time-of-use pricing; ELECTRIC UTILITIES/load management; PERFORMANCE; RATE STRUCTURE

38540 (EPRI-CU-6367-Vol.2 A.71) **Evaluation of TVA's energy saver home program.** Camp, W.A.; Hoch, L.J.; Mihlmester, P.E. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510--Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC UTILITIES/load management; HOUSES/energy conservation; ELECTRIC POWER; EVALUATION; HOUSES; TENNESSEE VALLEY AUTHORITY

38541 (EPRI-CU-6367-Vol.2 A.75) **Evaluation of direct load control programs.** Macphee, B.A. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510--Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC UTILITIES/load management; DATA ACQUISITION; ELECTRIC POWER; EVALUATION

38542 (EPRI-CU-6367-Vol.2 A.79) **Wisconsin's conservation competition pilot program: a progress report.** Nichols, D.; Saigo, H. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510--Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

COMMERCIAL BUILDINGS/energy conservation; ELECTRIC UTILITIES/load management; INDUSTRIAL PLANTS/energy conservation; RESIDENTIAL BUILDINGS/energy conservation; COMPETITION; ELECTRIC POWER; NATURAL GAS; WISCONSIN

38543 (EPRI-CU-6367-Vol.2 A.87) **Assessment and evaluation of Ohio Electric Utilities demand-side programs.** Scheck, G.C. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510--Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC UTILITIES/load management; BUILDINGS; ELECTRIC POWER; ENERGY CONSERVATION

38544 (EPRI-CU-6367-Vol.2 A.89) **Commercial building end-use intensities and load shapes based on the ELCAP sample of end-use metered buildings.** Taylor, Z.T.; Pratt, R.G. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510--Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

COMMERCIAL BUILDINGS/energy consumption; ELECTRIC UTILITIES/load management; ELECTRIC POWER; ENERGY CONSERVATION; METERING

38545 (EPRI-CU-6367-Vol.2, pp. 50.1-50.14) **Integrated resource planning: case studies of two Minnesota utilities.** Adiarte, A.L. (Dept. of Public Service, St. Paul, MN (USA)); Clark, E.; Krueger, G. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510--Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Least cost planning takes into account the repercussions of alternative supply and demand options on the utility and consumer. For the electric utility, the financial position, the reliability of customer service, and the type of generating capacity are of primary concern. Electricity is consumed directly as a means to satisfying end-use demands. This suggests that electric customers are likely to consider electric rates and expenditures (a component of the marginal cost of using the end-use), quality of the end-use service, and reliability of service as most important. A well-developed least cost plan will satisfy the goals of the consumer and utility in the most efficient (least cost) manner. This project is a case study evaluation of least cost plans for two fictitious upper midwestern utilities, Out-of-Town Power (OTP) and North Star Power (NSP). OTP is a moderately sized winter-peaking utility which annually sells about 3,000 GWh of electricity. OTP primarily serves residential and large commercial and industrial customers (C&I). Coal-fired capacity is the dominant fuel source used for generation, although wholesale purchases may serve more than one-third of retail energy requirements. NSP is a significantly larger summer-peaking utility which annually generates about 28,000 GWh. Roughly 90% of NSP's generation is from coal and nuclear power. Remaining energy sources include hydro, refuse derived fuel, natural gas, and oil. Large C&I customers account for almost half of NSP's retail energy sales, while residential and commercial (small C&I) customers consume close to 7,000 and 4,000 GWh, respectively. Integrated resource planning for the two case studies is discussed.

38546 (EPRI-CU-6367-Vol.2, pp. 51.1-51.9) **Least-cost resource planning in a changing business environment.** Mobasheri, F.; Walther, R.J.; Sioshansi, F. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510--Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The customer-driven resource plan adopted at Southern California Edison Company serves both the customer and shareholder. The strategy builds on previous planning with the continued emphasis on providing reliable electrical service at the lowest possible rates. Demand- and supply-side options are evaluated in developing the resource plan. The value of incorporating resource flexibility and uncertainty into the planning process is reinforced with the added uncertainty introduced with a customer-driven resource plan. The least-cost strategies recently adopted at SCE are focused on expanding customer choices and include the offering of pricing options, the introduction of technologies, the promotion of energy productivity, and the maintenance of resource flexibility. Finally, for customers to fully benefit from these customer-driven strategies, flexibility in the regulatory compact is required.

38547 (EPRI-CU-6367-Vol.2, pp. 52.1-52.9) **Demand-side management market penetration: modeling and resource planning perspectives from Central Maine Power.** Spellman, R.F. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510--Vol.2: 4. national conference on utility DSM programs: demand-site

management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Recent experience at Central Maine Power Company (CMP) indicates that it is very difficult to achieve the high levels of demand-side program market penetration (85% to 100%) which are suggested as possible by such organization as the Conservation Law Foundation, the Natural Resources Council of Maine, the New England Energy Policy Center, and the Rocky Mountain Institutes. A review of actual penetration experience in Maine and elsewhere in the country, and of very recent market penetration modeling efforts may be useful to resource planners interested in addressing critiques leveled at the industry's market penetration targets for demand-side programs. Ultimate market penetration estimates that CMP believes can be achieved in the residential, commercial and industrial sectors with demand-side management programs are addressed.

38548 (EPRI-CU–6367-Vol.2, pp. 53.1-53.15) **Developing optimum incentive levels for DSM programs using a customer acceptance model.** Limaye, D.R.; Sinha, J.; McDonald, C. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Incentive levels for DSM programs are generally calculated using one of two approaches: the customer payback method in which the incentive is calculated to make the DSM option economically attractive to the customer and utility avoided cost method in which the incentive is calculated based on the utility's avoided or marginal cost. Each of these methods has certain advantages and certain limitations, and often the incentive level is calculated using some compromise between these two approaches. A method is described for developing the optimum incentive level using a balanced perspective that accounts for both utility and customer considerations. The theoretical foundations of this approach are described, including a discussion of methods for estimating the market penetration (customer acceptance) function, and an example of an application of the approach to a rebate program designed by a major northeastern utility is presented.

38549 (EPRI-CU–6367-Vol.2, pp. 55.1-55.17) **Overview of utility commercial-sector DSM programs.** Rabl, V.A.; Blevins, R.P. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Annual sales to the commercial sector amount to about 550 trillion watthours, representing 25% of total electricity sales and 30% of summer peak demand. For most commercial buildings the bulk of electric consumption comprises lighting (40%), air conditioning (30%), and space heating (10%); however, the relative importance of different end uses varies significantly across customer types. Office buildings, for example, exhibit high space cooling loads, whereas retail establishments exhibit high lighting loads. For groceries, refrigeration emerges as the most important end use, whereas cooking stands out as the major end use for restaurants. With its diversity of customer and end-use types, the commercial sector represents a wealth of opportunities for meeting utility demand-side management (DSM) objectives. The results of a survey conducted in 1987 that identified and collected descriptive information on utility commercial-sector DSM programs are discussed. The results of this survey provide useful reference information to utilities interested in designing, implementing, or evaluating their own commercial DSM programs. This survey, which updates a similar commercial-sector survey conducted in 1984 represents the ninth utility program survey sponsored by EPRI since 1977.

38550 (EPRI-CU–6367-Vol.2, pp. 56.1-56.11) **Marketing interruptible rates to commercial and industrial customers: a case study.** George, S.S. (Putnam, Hayes & Bartlett, Inc., San Francisco, CA (USA)); Rodier, J.T. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

In the fall of 1987, Public Service of New Hampshire (PSNH) designed and marketed two interruptible rates for its nonresidential customer class. The two rate options (WI-PSNH and WI-NEPOOL) were offered to commercial and industrial (C/I) customers who agreed to reduce demand by a minimum of 300 kW upon request by PSNH. The rates were in effect during the months of December 1987 and January and February 1988. The program was marketed through a combination of mail, telephone and personal contacts to a target population of the 450 C/I customers whose maximum billing demands exceeded 300 kW. As a result of the low-level of customer acceptance, PSNH hired a consultant to evaluate both the design and marketing of the interruptible rates. The results of that investigation are summarized. How the recommendations from the investigation were implemented in the design of a new interruptible rate for 1988 and the dramatic increase in customer acceptance resulting from the changes are discussed. A brief description of the rate options originally offered by PSNH in the winter of 1987/88 and a summary of the evaluation that was conducted are presented. A discussion of the recommended changes that were developed for implementation of the new rate options is given and the results of the new rate campaign and plans for ongoing monitoring and evaluation are described.

38551 (EPRI-CU–6367-Vol.2, pp. 58.1-58.10) **Understanding and estimating industrial energy use for DSM program design.** Gandhi, N. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The classic DSM framework involving situational analysis, objectives settings, DSM option assessment and evaluation, program design and implementation, and program monitoring is as applicable to the industrial sector as it is to the residential and commercial sectors. But the diversity and complexity of industrial customers make it difficult to analyze and assess the impact of an appropriate DSM alternative. For the industrial sector, the DSM alternatives relate to one of the three major categories, i.e., process, end-use and schedule. A DSM planner will need different information for each of these strategies to be able to design and evaluate a DSM program. In the case of DSM alternatives that relate to industrial energy end uses, a DSM planner, at a minimum, needs to know if these uses exist and the equipment inventory in order to determine the applicability of a technology. Combining the data on processes, end uses, loads and operating schedule with business characteristics, decision-making characteristics, attitudes toward improving energy efficiency, and factors affecting investment decisions will provide the necessary information for DSM program design. The process of data development for DSM program design begins with defining information needs consistent with corporate objectives, examining the population of industrial customers, selecting data collection tools, developing an implementation plan to maximize customer participation, and analyzing results. Each step is discussed including the factors influencing the decision and the advantages and disadvantages of alternative approaches.

38552 (EPRI-CU–6367-Vol.2, pp. 59.1-59.10) **Utility needs assessment for industrial data.** Griffin, J.M.; Squitieri, R.; Meagher, P. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May

1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Throughout the United States, the industrial sector consumes about 40% of the total electricity produced and accounts for 36% of electricity sold by utilities. While the dominance of industrial sector electricity sales has steadily slipped over the last 15 years, the industrial sector is still the largest customer segment for most utilities. The industrial sector is financially attractive due to its size and because electricity is usually sold to industrial customers at a level above the average system load factor. Furthermore, the industrial customers of the electric utility generate indirect commercial and residential demand for electricity through their purchases of goods and services and the salaries and wages paid to workers. Thus the industrial sector represents a significant market for electricity due to its size, financial characteristics and importance for the service area's overall economic health. EPRI's Industrial Demand Side Management Data Project is designed to fill the need for developing and transferring a comprehensive set of data, methods, and tools to assist utilities in planning, analysis and implementation of industrial programs. A data base structured around the needs of key utility user groups is being developed and will be linked to existing models and data bases through various interface mechanisms. The content and structure of this project is described. The project has been guided by the results of a needs assessment obtained from utilities participating on the Project Advisory Committee.

38553 (EPRI-CU–6367-Vol.2, pp. 60.1-60.11) **Load research with finesse: working in a DOS environment.** Powers, J.T. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The trend toward decentralization of computing power in US industry appears to be irresistible. The utility industry is no exception, as it has experienced a dramatic increase in desktop computer usage over the past five years. However, utilities have lagged behind other industries in moving data analysis activities off mainframes and onto microcomputer workstations. The main obstacle to moving large data analysis jobs from mainframes to workstations is no longer technological; rather, it is the challenge of changing work habits and analysis techniques. The changes in analysis procedures are described that have been undertaken to successfully move the analysis of large-scale load monitoring projects from a mainframe environment into a DOS environment with the Load Data Analysis Workstation (LDAW). The design and specifications of the Workstation are described. How to change analysis techniques for doing load research in a desktop workstation environment so utilities can realize the substantial benefits of using workstations are discussed. The different analysis techniques appropriate for the microcomputer and mainframe environments as finesse and brute force, respectively are characterized.

38554 (EPRI-CU–6367-Vol.2, pp. 61.1-61.15) **Segmenting commercial/industrial markets for demand-side programs.** Boosalis, D.; Davis, T.D. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Commercial/industrial (C/I) markets represent important sources of opportunity for demand-side management (DSM). The identification of distinct customer segments within this market would enable utilities to tailor suitable marketing strategies, which would increase the efficiency and effectiveness of their DSM programs. Historically, the C/I market has been segmented by such predefined characteristics as business type or SIC, the number of employees, energy use levels, the type of building occupied, size of building, etc. Growing in importance is the segmentation of the C/I market for DSM programs based on the needs/benefits of business, including such factors as preference regarding increased reliability, access to capital, more flexibility, lower operating cost, and so on. Very few utilities in the United States have completed need/benefit segmentation studies of the commercial/industrial market. A review of this very unique approach to segmenting C/I markets based on the needs/benefits of businesses served by the Omaha Public Power District (OPPD) is presented.

38555 (EPRI-CU–6367-Vol.2, pp. 62.1-62.9) **Influencing professionals in the commercial new construction market.** Kreitler, V.L. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The new construction market offers substantial opportunities to utilities promoting demand-side management (DSM) programs. A number of factors should predispose this market to higher participation rates than the retrofit market, including: a readiness to purchase equipment, more economical installations, and less severe facility-related constraints. In addition, the influence wielded by architects, engineers, and developers should enable utilities to affect a large number of building projects by influencing a relatively small number of decision-makers. However, utility experience with the new construction market has been marked by a notable lack of program participation, low installation rates of targeted technologies, and limited contact with key professionals in the trade. In response to this problem, Synergic Resources Corporation undertook a study of building design and equipment selection decision-making in commercial construction projects. Interviews with upper management of engineering, architectural, and development firms across the country were used to explore what factors determine the outcomes of specification decisions. The results of the study are presented.

38556 (EPRI-CU–6367-Vol.2, pp. 63.1-63.10) **Market research in a regulatory setting: the Wisconsin commercial segmentation study.** Prahl, R.; Worel, J.; Kreitler, V. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

With the help of a grant from the US Department of Energy, the Public Service Commission of Wisconsin (PSCW) has initiated a project to segment the market for energy efficiency improvements in Wisconsin's commercial sector. Recognizing that acceptance of demand-side management (DSM) programs varies among customer groups, segmentation analysis was selected to identify and characterize the market's heterogeneity in ways meaningful to the PSCW and Wisconsin utilities. Disaggregation of the market into more homogeneous segments will enable DSM planners to identify target markets and better gauge market potential for a variety of programs and services. These results are expected to reduce the uncertainty surrounding commercial sector programs and to allow for better resource allocation among the array of available DSM alternatives. This study goes beyond most segmentation projects in that segmentation-related analyses are to be performed on three different geographic levels. First, a stratified random sample is to be drawn and analyzed for the state as a whole. Second, oversampling is to be performed, and individual segmentation analyses conducted, for four of the nine utilities participating in the study. Third, in order to help assess market variations and transferability issues, the results of the state- and individual utility-level analyses are to be compared. Results of the study are presented.

38557 (EPRI-CU–6367-Vol.2, pp. 64.1-64.6) **Energy management programs for large commercial and industrial electric utility customers.** Linn, J.J. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility

DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Central Maine Power Company (CMP) is working with its largest commercial and industrial (C&I) customers to improve their electrical energy efficiency. The Company has concentrated on this group of customers for two years, using and developing innovative demand-side management (DSM) programs to meet their special needs. CMP's DSM programs for large C&I customers are built upon a foundation of experience with other customer groups, and a corporate attitude which encourages improvement in energy efficiency. The results of two years' experience with these customer DSM programs have directed CMP to continue and enhance their use, as well as to develop new ways to help their large C&I customers. The results of CMP's experience with these programs is discussed.

38558 (EPRI-CU–6367-Vol.2, pp. 65.1-65.14) **NEES stand-by generations program: design, results, and lessons learned.** Nadel, S.M.; Cress, K.; Ticknor, M. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The New England Electric System (NEES) Stand-By Generation Program provides incentives to customers with stand-by generation equipment (emergency generators) to operate their generators during peak demand periods, thereby reducing loads imposed on the utility system by these customers. In all cases, customer generated electricity is used to service that customer's electricity needs. No power flows back to the utility. Thus, stand-by generation is limited to electrical loads that are connected to the stand-by generator and that can be safely switched to the stand-by generator. The NEES Stand-by Generation Program has shown that stand-by generation equipment can be a significant peak resource. This resource can be obtained at a cost substantially lower than that for a peaking gas turbine. NEES companies have achieved a high enrollment rate after only one year by emphasizing a simple program design and extensive personal marketing. Customers respond to the stand-by generation program because of financial incentives, the opportunity to improve to do their part to help deal with a very tight regional power supply situation. In the coming year, as a result of recent program changes, the NEES companies will be striving to enroll more customers in the program and to improve participation levels on each generation day.

38559 (EPRI-CU–6367-Vol.2, pp. 66.1-66.13) **Load reduction and operational performance of commercial cool storage systems.** Sterrett, R.; Strickler, G.; Steudtner, E. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Cool storage is a demand-side management tool which reduced the electrical demand of a cooling system during the utility peak period. Southern California Edison (SCE) has actively promoted this concept through incentive programs and special rate structures. To better understand the technology, a program to monitor and evaluate the operation of several cool storage systems was initiated. Three cool storage systems were evaluated as part of the Electric Power Research Institute's (EPRI) Commercial Cool Storage Field Performance Monitoring Program. Monitoring results have been used by building owners to improve the performance of the three systems. The monthly peak period demand reduction at one of the sites went from approximately 100 kW to over 400 kW as a result of recommendations and feedback provided by the monitoring. Cool storage system monitoring proved to be so successful that SCE has started a portable monitoring program to verify proper system operation and subsequent demand reduction. Four sites were monitored during the 1988 cooling season. The results of SCE's monitoring programs indicate that cool storage systems are effective in reducing the peak period demand and energy usage, although their performance can be improved by applying the monitoring results.

38560 (EPRI-CU–6367-Vol.2, pp. 67.1-67.10) **Electric utility planning in light of global climate change concerns.** Tempchin, R.; Makhijani, A. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Power plant emissions are an environmental issue that has a major impact on electric utility demand-side and supply-side planning. If Congress enacts legislation aimed at controlling emissions in light of global climate change or other concerns, utility planning will have to incorporate cost-effective options to meet future regulatory requirements. While planning decisions have become increasingly complex because of various financial, regulatory, and environmental changes, today's challenges offer utilities an opportunity to implement resource plans (both demand- and supply-side) to meet the goals and needs of customers, stockholders, and society - including environmental protection. Options for utility short- and medium-range planning are presented in light of global climate change concerns. Various alternatives for complying with possible regulations concerning global climate change (commonly referred to as the greenhouse effect) are discussed. These alternatives include demand-side management (DSM) programs - including investments in efficient end-use electric equipment - and customer fuel switching options, with specific examples given of DSM activities which might reconcile some of the goals and needs. Supply-side choices are also discussed. Areas where further research is needed to understand the implications of possible global climate change legislation are explored.

38561 (EPRI-CU–6367-Vol.2, pp. 68.1-68.11) **Key elements of legislative and regulatory framework for using energy conservation to reduce acid rain compliance costs.** Frimerman, L.A. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Electric utilities will be facing many complex problems in the near-term: Acid rain and global warming reductions, regulations for electricity load forecasting and least-cost or integrated resource plans. The costs for each of these individual efforts will be high, and the solutions to one problem can exacerbate another. Energy conservation programs can be used to address a portion of each of these problems. By investing in energy conservation, utilities can sharply reduce program costs in many areas at once. Key elements necessary to help utilities and states plan effectively and coherently are identified. How one can reduce acid rain costs through cost-effective energy conservation and least emission dispatch is discussed. How the legislative and regulatory conditions necessary to facilitate the integration of energy conservation programs into a major utility emission reduction and load forecasting/management strategy is addressed. The study draws upon the Ohio Consumers' Counsel study, Clearing the Air, which showed that a 60% savings, representing billions of dollars, could be achieved in Ohio by coupling energy conservation and least emission dispatch with a flexible acid rain compliance program. In order to properly credit the reductions made through energy conservation and least emission dispatch, the study finds that legislation must be fashioned to include these provisions: operator-specific statewide annual tonnage ceilings, rather than emission rate limitations; interstate emission reductions banking and trading provisions; and state and federal coordination.

38562 (EPRI-CU–6367-Vol.2, pp. 69.1-69.16) **Climate change and electric utilities.** Richels, R. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Possible climate changes brought about by increases in so-called greenhouse gases represent a particularly important issue for the electric utility industry for at least two reasons. First, although utilities are by no means the dominant source of greenhouse gases, they remain major contributors and a likely target for future regulation aimed at reducing climate change. Second, and perhaps more importantly, utilities may experience significant operational impacts resulting from changes in such climate variables as temperature and precipitation. The operational impacts of climate change on electric utilities, particularly those related to demand-side planning are discussed. The state of scientific knowledge about global climate change and the importance of utilities as a source of greenhouse gases are reviewed.

38563 (EPRI-CU–6367-Vol.2, pp. 70.1-70.11) **Demand-side management component of an integrated bidding program.** Onofry, R.; Cole, W.J. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Orange and Rockland Utilities (ORU) is the final stages of developing and issuing a Request for Proposals (RFP) from bidders to provide both supply and demand side management (DSM) resources. The New York Public Service Commission (PSC) has indicated that bidding will be the method of choice for acquiring resources to meet future electricity supply needs. In May of 1988, the PSC directed each of the State's seven major investor-owned utilities to develop bidding plans and submit them for review and comment. Since it also serves customers in New Jersey, ORU's bidding program must also conform to the provisions of a stipulation agreement among utilities, independent power producers, and the New Jersey Board of Public Utilities (BPU). The following issues are addressed: (1) the regulatory context and prior utility experience with DSM bidding which impacted the design of the bidding program; (2) the market, regulatory, and program management factors which were considered in designing the DSM component of the bidding plans; (3) the results of market research which evaluated the potential interest of ORU's large commercial and industrial customers and energy service companies in participating in the DSM component of this bidding program; (4) the comments submitted by the New York PSC staff on the DSM component of ORU's bidding plan; (5) a general description of the major bidding program changes ORU plans to make in response to these comments; and (6) a summary description of how ORU plans to evaluate the DSM impacts from conducting this initial bidding program; the results of this evaluation effort will be used by ORU in determining whether any changes should be made in any future bidding cycles.

38564 (EPRI-CU–6367-Vol.2, pp. 71.1-71.10) **Bidding methods, evaluation, and tactics.** LeBlanc, W. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Bidding for new electric resources has recently emerged as an alternative to traditional utility generation development. Although the initial set of utility bidding programs has gathered much interest from independent power producers (IPP), it remains too early to determine the long-term viability of this form of procurement. Bidding has brought many key industry issues to the forefront: What role can demand-side management play in the overall resource plan? Can IPPs really produce power at a lower cost than a regulated utility? Is transmission access the cornerstone to future power markets? Utilities will certainly develop new skills to cope with the changing environment, and look beyond traditional boundaries to find new business opportunities. Although bidding has been accepted by several state commissions and utilities, many questions still remain as to its long-term effectiveness as a resource procurement method. The long-term financial implications to investor-owned utilities still remain an unanswered questions, as does the quality and reliability of service issue. With this quickly changing business environment, careful yet rapid examination of results from bidding programs will be extremely important. Since the electric power resources for the next 25 years are being chosen today, much is as stake for utilities, customers, and independent producers.

38565 (EPRI-CU–6367-Vol.2, pp. 72.1-72.8) **Demand-side bidding: the non-participant test and economic efficiency.** Stanley, W. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

There has been a remarkable durability of certain misconceptions concerning the non-participant test, also known as the no-losers test or the rate impact measure. Prominent among these misconceptions is the notion that requiring utility-sponsored conservation programs to pass the non-participant test constitutes an unfair and uneconomic tilt of the playing field. This is because, it is often argued, supply-side alternatives are not required to pass a similar test. It is shown mathematically that the essence of the non-participant test is a direct comparison between demand-side programs and the least-cost supply-side alternatives. That is, a utility-sponsored conservation program fails the non-participant test if, and only if, it would increase rates above what would prevail if, instead of conservation, the supply-side alternatives were pursued. There is no tilt to the playing field. The non-participant test is consistent with the original intent of utility-sponsored conservation programs. That intent was to overcome the perceived market imperfection that retail rates were less than marginal costs.

38566 (EPRI-CU–6367-Vol.2, pp. 73.1-73.14) **Bidding conservation against cogeneration: the level playing field.** Estey, D.P. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

State and federal regulatory bodies are steadily increasing the pressure on utilities to pursue a least cost strategy for procuring future energy resources. Both regulators and utilities agree that utility investment in demand side energy management (DSM) programs for their customers is part of this least-cost strategy. Several utilities, state agencies and the Federal Energy Regulatory Commission (FERC) are exploring methods of purchasing demand side energy management (DSM) on a competitive basis comparable to the purchase of supply from qualifying facilities under the definitions of the Public Utility Regulatory Policies Act (PURPA). The development and the experience, to date, of Central Maine Power Company's effort to conduct an all source bidding program, entitles the Pilot Power Partners Program are described.

38567 (EPRI-CU–6367-Vol.2, pp. 74.1-74.12) **Demand-side management in Austria and Germany: selected programs.** Lesch, K.H. (Univ. of Muenster (Germany, F.R.)); Bach, W. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings,*

Volume 2. Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Fundamental changes in our world suggest the need to alter the path we have followed the last century to supply energy for a growing society. Environmental consequences of increasing fossil fuel combustion, such as acid rain and the greenhouse effect, are well known. One of the results of the 1988 World Climate Conferences (e.g. Toronto and Hamburg) was an agreement on a tolerable ceiling for the mean global warming of 1° to 2° C by 2100 as compared to the preindustrial value. To reach this goal, calculation shows that the global 20 Gt of CO_2 emissions have to be reduced drastically. The potentially dramatic adverse environmental effects of continued reliance on fossil fuel combustion require a complete restructuring of our energy system. An international convention for the reduction of the emission of atmospheric pollutants and greenhouse gases should be initiated as soon as possible. All groups within the energy system, e.g. utilities, industry, customers, and governments, should be involved. Supply-side options cannot reduce environmental risks as much as demand-side management. Utilities should increase combined heat and power generation and district heating, help customers to improve their efficiency, and sell energy services instead of energy.

38568 (EPRI-CU–6367-Vol.2, pp. 75.1-75.12) **Uppdrag 2000: developing the future.** Kruse, K.L. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Sweden is a country about the size of California with eight million inhabitants. The climate is quite like the climate in Minnesota, e.g., cold winters and warm but not hot summers. More than 2/3 of the country's production is sold abroad. Metal engineering, wood and paper products and advanced technology equipment dominate the export market. This country has one of the world's highest electricity consumption rates. Up to now, Sweden has been able to maintain low electricity prices in a power system where hydropower and nuclear power together provide more than 90% of the output. A limited amount of industrial backpressure and combined heat and power is also used. On the demand side there is uncertainty as to whether the present growth rate will continue. The low oil prices, a presumed decline in the willingness of the industry to make investments and expected future electricity prices 50-100% higher than today all contribute to this uncertain picture. The energy supply situation in Sweden is discussed.

38569 (EPRI-CU–6367-Vol.2, pp. 76.1-76.15) **DSM down under.** Wathen, G.; Gallaugher, J.; Williams, M. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The State Electricity Commission of Victoria (SECV) and the Victorian State Department of Industry, Technology and Resources (DITR) recently embarked on a major project to identify the role and potential impacts of demand-side programs in meeting Victoria's future electricity needs. Demand-side planning is an area which has not yet been given a great deal of attention in Australia and is therefore at an early stage of development in comparison to the progress which has been made in North America. A standing committee of the Victorian Parliament, the Natural Resources and Environment Committee (NREC), recently conducted an inquiry into Electricity Supply and Demand Beyond the Mid-1990s. The terms of reference required the Committee to report on the most appropriate sequencing of future power supply options to follow the power station currently being constructed. The committee's recommendations focused on the need to develop an integrated least-cost planning methodology which would better handle the uncertainty of future load growth and risks associated with large capital expenditure projects with long lead times, and allow supply- and demand-side options to be evaluated on an equal basis. While NREC felt a further public inquiry into demand-side issues was needed, a government decision on this has been deferred. Instead, the SECV and DITR are jointly undertaking a 12-month Demand Management Development Project. This study is discussed.

38570 (EPRI-CU–6367-Vol.2, pp. 77.1-77.8) **Mintop Project.** Ottosson, H. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The second largest utility in Sweden - Sydkraft AB - has seen its power system changing from an energy dimensioned system to a power dimensioned system. One of the reasons is overall load growth. Load forecasts project a need for 100 MW peak generating capacity during cold winter days in 1991/92. The maximum load during such a day will be on the order of 4,880 MW. In particular, the increased use of electric heating at residential premises causes very sharp winter peaks. The first steps toward demand-side management taken by a Swedish production utility are discussed. Estimates of the total load in Sweden during a peak day in the 1991/92 range is from 27,500 to 28,000 MW. Since time is short until the peak demand has to be reduced (or a gas turbine built), the study was directed toward determining how, and in which market areas, demand-side management could be employed. The activities are concentrated on direct electric heating and electric boiler systems.

38571 (EPRI-CU–6367-Vol.2 A.15-A.16) **True experiment in utility commercial lighting marketing.** Hughes, N.; Clinton, J. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

COMMERCIAL BUILDINGS/lighting loads; ELECTRIC UTILITIES/load management; INDUSTRIAL PLANTS/lighting loads; ELECTRIC POWER; MARKETING

38572 (EPRI-CU–6367-Vol.2 A.123-A.124) **Market success: it's who you know that counts.** Garrett, B.A.; Mohler, B.L. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC POWER/marketing; ELECTRIC UTILITIES/load management; ENERGY CONSERVATION/marketing; MARKETING; PLANNING

38573 (EPRI-CU–6367-Vol.2 A.125-A.126) **Annual marketing planning: the bridge from the strategic to the tactical.** Jacobson, M. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC POWER/marketing; ELECTRIC UTILITIES/load management; MARKETING; PLANNING

38574 (EPRI-CU–6367-Vol.2 A.127) **Development and implementation of a comprehensive training program for utility marketing service representatives.** Mashburn, W.H.; Caskey, J. Electric Power Research Inst., Palo Alto, CA (USA); Synergic

Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC UTILITIES/load management; ENERGY MANAGEMENT/education; ELECTRIC POWER; EDUCATION; IMPLEMENTATION; MARKETING; TRAINING

38575 (EPRI-CU–6367-Vol.2 A.129) **Market assessment of remaining DSM potential among CMP's electric space heating customers.** Michelsen, L. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC POWER/marketing; ELECTRIC UTILITIES/load management; MARKETING; RESIDENTIAL BUILDINGS; SPACE HEATING

38576 (EPRI-CU–6367-Vol.2 A.131) **Comparing the success of a marketing vs. mandatory approach to achieving high efficiency building practices.** O'Neill, M. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC POWER/marketing; ELECTRIC UTILITIES/load management; MARKETING; ENERGY CONSERVATION; ENFORCEMENT

38577 (EPRI-CU–6367-Vol.2 A.135) **Abstract for customizing an integrated planning approach: three utilities' experience.** Bubb, S.R. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC UTILITIES/load management; ELECTRIC UTILITIES/planning; COMPETITION; DATA ACQUISITION; ELECTRIC POWER; PLANNING

38578 (EPRI-CU–6367-Vol.2 A.137) **Long-term utility planning: how significant is demand-side management.** Dowlatabadi, H. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC UTILITIES/load management; ELECTRIC UTILITIES/planning; DECISION MAKING; ELECTRIC POWER; PLANNING

38579 (EPRI-CU–6367-Vol.2 A.139) **Uncertainty in long-term resource planning for electric utilities.** Hirst, E.; Schweitzer, M. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC UTILITIES/load management; ELECTRIC UTILITIES/planning; DECISION MAKING; ELECTRIC POWER; PLANNING; RESOURCE MANAGEMENT

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ELECTRIC UTILITIES/load management; DECISION MAKING; ELECTRIC POWER; EVALUATION; PLANNING

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ELECTRIC UTILITIES/load management; CAPACITY; ELECTRIC POWER; EVALUATION; RELIABILITY

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ELECTRIC UTILITIES/load management; ELECTRIC POWER; LINEAR PROGRAMMING; OPTIMIZATION; RESOURCE MANAGEMENT

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ELECTRIC UTILITIES/load management; COMMERCIAL SECTOR; ELECTRIC POWER; INDUSTRY

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APPLIANCES/control; ELECTRIC UTILITIES/load management; APPLIANCES; CONTROL; ELECTRIC POWER; ENERGY CONSERVATION; MARKET; RESIDENTIAL SECTOR

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ELECTRIC POWER/cost; ELECTRIC UTILITIES/load management; COST; RESIDENTIAL SECTOR

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ELECTRIC UTILITIES/load management; COST; ELECTRIC POWER; EQUIPMENT; MARKETING

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COMMERCIAL SECTOR/energy consumption; ELECTRIC UTILITIES/load management; ELECTRIC POWER; IMPLEMENTATION

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APPLIANCES/energy consumption; ELECTRIC UTILITIES/load management; APPLIANCES; COST; DATA ACQUISITION; ELECTRIC POWER; RESIDENTIAL SECTOR

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ELECTRIC UTILITIES/load management; ELECTRIC UTILITIES/planning; COMMERCIAL SECTOR; DATA ACQUISITION; ELECTRIC POWER; PLANNING; MARKETING; RESOURCE MANAGEMENT

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ELECTRIC UTILITIES/load management; ELECTRIC POWER; ENERGY CONSUMPTION; HOUSES; REGIONAL ANALYSIS

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ELECTRIC POWER/outages; ELECTRIC UTILITIES/load management; ATTITUDES; COST; OUTAGES; POWER GENERATION; PUBLIC OPINION; RATE STRUCTURE

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ELECTRIC UTILITIES/load management; RESIDENTIAL SECTOR/energy conservation; APPLIANCES; ELECTRIC POWER

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ELECTRIC UTILITIES/load management; WATER HEATERS/control systems; ELECTRIC POWER; ENERGY CONSERVATION; POWER GENERATION

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ELECTRIC UTILITIES/load management; LIGHTING SYSTEMS/energy conservation; RESIDENTIAL BUILDINGS/lighting systems; ELECTRIC POWER; FLUORESCENT LAMPS; MARKETING

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ELECTRIC POWER/metering; ELECTRIC UTILITIES/load management; AUTOMATION; DATA ACQUISITION; METERING; METERS

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ELECTRIC UTILITIES/load management; HEAT STORAGE/feasibility studies; RESIDENTIAL BUILDINGS/space heating; ELECTRIC POWER; RATE STRUCTURE

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ELECTRIC UTILITIES/load management; REFRIGERATORS/energy conservation; ELECTRIC POWER; REFRIGERATORS; RESIDENTIAL BUILDINGS

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ELECTRIC UTILITIES/load management; GROUND SOURCE HEAT PUMPS/energy conservation; GROUND SOURCE HEAT PUMPS/marketing; ELECTRIC POWER; MARKETING; TECHNOLOGY ASSESSMENT

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ELECTRIC UTILITIES/load management; WATER HEATERS/energy conservation; WATER HEATERS/thermal insulation; ELECTRIC POWER; MARKETING; RESIDENTIAL SECTOR

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COMMERCIAL BUILDINGS/energy storage systems; ELECTRIC UTILITIES/load management; ENERGY STORAGE SYSTEMS/control systems; ELECTRIC POWER; ENERGY CONSERVATION; SENSIBLE HEAT STORAGE

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ELECTRIC UTILITIES/load management; SENSIBLE HEAT STORAGE/feasibility studies; ELECTRIC POWER; ENERGY CONSERVATION; MARKETING; TECHNOLOGY ASSESSMENT

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ELECTRIC UTILITIES/load management; GAS FURNACES/energy efficiency; GAS FURNACES/performance; HEAT PUMPS/energy efficiency; HEAT PUMPS/performance; COMPARATIVE EVALUATIONS; ELECTRIC POWER; PERFORMANCE; MARKETING

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ELECTRIC UTILITIES/load management; COST; ELECTRIC POWER; ENERGY CONSERVATION; PLANNING

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ELECTRIC UTILITIES/load management; LOAD MANAGEMENT/research programs; ELECTRIC POWER; PLANNING

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ELECTRIC UTILITIES/load management; ELECTRIC POWER; ENERGY CONSERVATION; ENERGY EFFICIENCY; PRODUCTIVITY

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ELECTRIC UTILITIES/load management; COST; ELECTRIC POWER; ENERGY CONSERVATION; PLANNING

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ELECTRIC POWER/cost; ELECTRIC UTILITIES/load management; COST; PUBLIC UTILITY REGULATORY POLICIES ACT

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ELECTRIC UTILITIES/load management; LIGHTING SYSTEMS/installation; ELECTRIC POWER; LIGHTING LOADS; INSTALLATION

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ELECTRIC UTILITIES/load management; COMPETITION; COST; ELECTRIC POWER

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ELECTRIC UTILITIES/load management; COMPETITION; COST BENEFIT ANALYSIS; ELECTRIC POWER; PLANNING

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ELECTRIC UTILITIES/load management; ENERGY CONSERVATION/marketing; RESIDENTIAL SECTOR/energy conservation; ELECTRIC POWER; MARKETING

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ELECTRIC UTILITIES/load management; ENERGY CONSERVATION/marketing; RESIDENTIAL BUILDINGS/energy conservation; ELECTRIC POWER; MARKETING; PRICES; RATE STRUCTURE

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ELECTRIC UTILITIES/load management; POWER GENERATION/cost; ELECTRIC POWER; COST

38616 (EPRI-CU-6367-Vol.2 A.201-A.202) **Equity cost component in evaluating non-utility generation proposals.** Olsoni, K. Jr. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510--Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC POWER/procurement; ELECTRIC UTILITIES/load management; BIDS; CONTRACTS; COST; ECONOMIC ANALYSIS; PROCUREMENT; POWER GENERATION

38617 (EPRI-CU-6367-Vol.2 A.205) **Using utilities to provide government sponsored energy programs: an overview of international experience.** Kirchen, S.J. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510--Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC UTILITIES/load management; ELECTRIC POWER; ENERGY CONSUMPTION; ENERGY SUPPLIES; INTERNATIONAL RELATIONS; REVIEWS

38618 (EPRI-CU-6367-Vol.2 A.31-A.32) **Customer decision-making under real-time pricing.** Crane, C.M. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510--Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC POWER/prices; ELECTRIC UTILITIES/load management; DECISION MAKING; PRICES; MARKETING; REAL TIME SYSTEMS

38619 (EPRI-CU-6367-Vol.2 A.33-A.34) **Practical applications of real-time pricing concepts: the dispatchable demand rate.** LeBlanc, W.; Hanser, P. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510--Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC POWER/prices; ELECTRIC UTILITIES/load management; COST; PRICES; POWER DEMAND; REAL TIME SYSTEMS

38620 (EPRI-CU–6367-Vol.2 A.35-A.36) **Residential bill disaggregation for DSM promotion.** McRai, M.; Adams, A. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC POWER/time-of-use pricing; ELECTRIC UTILITIES/load management; RESIDENTIAL BUILDINGS/power demand; ENERGY CONSUMPTION

38621 (EPRI-CU–6367-Vol.2 A.37-A.38) **Flint Electric Membership Corporation residential time-of-use rate project.** Schuler, C.D. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC POWER/time-of-use pricing; ELECTRIC UTILITIES/load management; RESIDENTIAL BUILDINGS/energy consumption; RESIDENTIAL BUILDINGS/power demand

38622 (EPRI-CU–6367-Vol.2 A.43-A.44) **Pioneering process to develop energy conservation programs.** Taylor, E.F. Jr. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC UTILITIES/load management; ENERGY CONSERVATION/implementation; AGREEMENTS; ELECTRIC POWER; IMPLEMENTATION; REGULATIONS

38623 (EPRI-CU–6367-Vol.2 A.47-A.48) **Least-cost options? generalizations from the empirical data.** LaMontagne, J.; Sabo, C.; Pierce, B. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC UTILITIES/load management; COST BENEFIT ANALYSIS; DATA ACQUISITION; ELECTRIC POWER

38624 (EPRI-CU–6367-Vol.2 A.59-A.60) **Design and use of the indepth equipment model for market planning and forecasting.** Hummel, P.E.; Roop, J.; Squitieri, R.; Skelton, J.C. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC UTILITIES/load management; COMPUTERIZED SIMULATION; ELECTRIC POWER; FORECASTING; MARKETING; PLANNING

38625 (EPRI-CU–6367-Vol.2 A.61-A.62) **Energy management information and implementation system for marketing and demand-side management (EMI^2 system).** Landsberg, D.R.; Fleming, W.S. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC UTILITIES/load management; ENERGY MANAGEMENT/implementation; ELECTRIC POWER; ENERGY CONSERVATION; IMPLEMENTATION; INFORMATION NEEDS; MARKETING

38626 (EPRI-CU–6367-Vol.2 A.63-A.65) **Use of the ASSESS computer program for least-cost utility planning.** Steigelmann, W.J.; Hoch, L.J.; Hinkle, B.K.; Tribken, B.E. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC UTILITIES/load management; A CODES; COST; ELECTRIC POWER; PLANNING

38627 (EPRI-CU–6367-Vol.2 A.73-A.74) **Analysis of energy audit programs to determine the most effective audit procedures.** Harris, L.R.; Snapp, D. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC UTILITIES/load management; RESIDENTIAL BUILDINGS/energy audits; COMPUTER CODES; ELECTRIC POWER; ENERGY CONSERVATION

38628 (EPRI-CU–6367-Vol.2 A.77-A.78) **Major weatherization impacts on space heating requirements or the intersection of prediction and performance.** Miller, N.E. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC UTILITIES/load management; RESIDENTIAL BUILDINGS/energy conservation; RESIDENTIAL BUILDINGS/weatherization; ELECTRIC POWER; WEATHERIZATION; SPACE HEATING

38629 (EPRI-CU–6367-Vol.2 A.81-A.82) **Setbacks and peak loads in commercial buildings.** Pratt, R.G. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

COMMERCIAL BUILDINGS/energy conservation; ELECTRIC UTILITIES/load management; ELECTRIC POWER; POWER DEMAND; SPACE HVAC SYSTEMS

38630 (EPRI-CU–6367-Vol.2 A.83-A.84) **Breakthroughs in end-use metering for program monitoring and evaluation.** Robison, D.; Landwehr, D. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

COMMERCIAL BUILDINGS/energy consumption; ELECTRIC UTILITIES/load management; DATA ACQUISITION; ELECTRIC POWER; METERING; MONITORING

38631 (EPRI-CU–6367-Vol.2 A.85-A.86) **Evaluation of the energy and demand effects of Wisconsin Electric Power Company's Smart Money conservation program.** Rogers, E.A. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

COMMERCIAL BUILDINGS/energy conservation; ELECTRIC UTILITIES/load management; INDUSTRIAL PLANTS/energy conservation; RESIDENTIAL BUILDINGS/energy conservation; ELECTRIC POWER; EVALUATION; FINANCIAL INCENTIVES

38632 (EPRI-CU–6367-Vol.2 A.9-A.13) **Graphical spreadsheets: a tool for demand side management planning.** Gillman, R.A.; Moe, R.J. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC UTILITIES/load management; ELECTRIC POWER; ENERGY CONSERVATION; PLANNING

38633 (EPRI-CU–6367-Vol.2 A.91-A.92) **Comprehensive demand-side evaluation at Northern States Power Company of Wisconsin.** Vig, K.; Gehring, B.; Bubb, S.; Zuck, D. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

COMMERCIAL BUILDINGS/energy conservation; ELECTRIC UTILITIES/load management; INDUSTRIAL PLANTS/energy conservation; RESIDENTIAL BUILDINGS/energy conservation; ELECTRIC POWER; EVALUATION

38634 (EPRI-CU–6367-Vol.2 A.93-A.94) **Energy savings and self-selection bias: application and interpretation.** Violette, D.M.; Buchanan, D.L.; Stanley, L. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC UTILITIES/load management; RESIDENTIAL BUILDINGS/energy conservation; ELECTRIC POWER; REGRESSION ANALYSIS

38635 (EPRI-CU–6367-Vol.2 A.97-A.98) **Statewide least-cost planning – an inventory-based approach to program design.** Hoffman, M.G. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC UTILITIES/load management; ENERGY CONSERVATION/technology assessment; COST; ELECTRIC POWER; PLANNING

38636 (EPRI-CU–6367-Vol.2 A.99-A.100) **Rhode Island least cost planning project - a model for statewide cooperative DSM program design.** Kilmarx, M.; Hicks, E. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). 1989. (CONF-890510–Vol.2: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, Cincinnati, OH (USA), 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings, Volume 2.* Order Number DE89011797/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

ELECTRIC UTILITIES/load management; ENERGY CONSERVATION/implementation; COST; ELECTRIC POWER; IMPLEMENTATION; PLANNING

38637 (NEI-DK–172, pp. 73-87) **High indirect taxes on natural gas.** Lund, H. (Aalborg Universitetscenter (DK)). Teknologiraadets Styregruppe for Vedvarende Energi, Copenhagen (Denmark). 1987. (In Danish). (CONF-8710469–: Conference on decentral dual-purpose power plants, Moltkes Palae (Denmark), 26 Oct 1987). In *Decentral dual-purpose power plants.* Order Number DE89776141/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

A description of the actual situation in Denmark regarding economical feasibility of producing electric power as compared to heat in relation to current taxing system and pricing regulations, and in relation to the type of fuel utilized, with the emphasis on natural gas. (AB) 14 refs.

38638 (SECV-GO–88-148) **SECV Research and Development Department. Research Program 1988.** Crosby, A.; Coddington, D. State Electricity Commission of Victoria, Melbourne (Australia). Research and Development Dept. 1988. 160p. Available from State Electricity Commission of Victoria, Melbourne (Australia). Research and Development Dept.

This document summarises the current research program at the Herman Research Laboratory. The objectives and scope of each research project, and progress during 1987/88 are presented. Projects included are those current at the start of Financial Year 1988/89.

2980 Consumption and Utilization

Refer also to citation(s) 38567, 38657

38639 (DOE/EIA–0354(81)) **State energy overview.** USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Markets and End Use. Sep 1982. 240p. Sponsored by DOE Management & Administration. Order Number DE89014994/JAW. Available from NTIS, PC A11/MF A01 - OSTI; GPO Dep.

This publication presents an overview of selected energy-related data for the United States, for each State, and for the District of Columbia. Included are the quantities of energy produced and consumed, estimates of fuel reserves, and the value of nonrenewable fuels produced by type. Also provided for each State are selected demographic and energy-related information that have been ranked and expressed as a percent of the national total. This overview provides a ready reference and a quick access to selected State energy information and State rankings for various socioeconomics and energy items.

2990 Unconventional Sources and Power Generation

Refer also to citation(s) 38510

38640 (NEI-DK–172, pp. 11-26) **Towards a reduction in fuel consumption. Possibilities for action in respect of energy policy.** Illum, K. Teknologiraadets Styregruppe for Vedvarende Energi, Copenhagen (Denmark). 1987. (In Danish). (CONF-8710469–: Conference on decentral dual-purpose power plants, Moltkes Palae (Denmark), 26 Oct 1987). In *Decentral dual-purpose power plants.* Order Number DE89776141/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The importance of reducing global pollution was emphasized in relation to the necessity of cutting down on energy consumption. Decentral dual-purpose power plants driven by natural gas or renewable energy resources were advocated, as was the development and electrification of public transport facilities. It was postulated that the present tariff and pricing system in relation to energy production should be drastically re-organized. (AB).

38641 (NEI-DK–172, pp. 5-9) **Decentral dual-purpose power plants in relation to energy policy.** Meyer, N.I. (Teknologiraadets Styregruppe for Vedvarende Energi (DK)). Teknologiraadets Styregruppe for Vedvarende Energi, Copenhagen (Denmark). 1987. (In Danish). (CONF-8710469–: Conference on decentral dual-purpose power plants, Moltkes Palae (Denmark), 26 Oct 1987). In *Decentral dual-purpose power plants.* Order Number DE89776141/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

Renewed initiatives in relation to the co-ordination of energy and environmental protection policies were strongly advocated. It was suggested that in this respect it was of primary importance to develope a more efficient use of energy. Prices should be drastically reduced where natural gas and renewable energy sources were used for fuelling decentral dual-purpose power plants and the latter should produce electric power when consumption is reckoned to be highest. It was strongly recommended that the current tariff system should be re-organized. (AB).

30 DIRECT ENERGY CONVERSION

3001 MHD Generators

38642 (CONF-890671–1) **An open-cycle magnetohydrodynamic power plant with CO_2 recycling.** Berry, G.F. Argonne National Lab., IL (USA). 1989. 10p. Sponsored by DOE Fossil Energy. DOE Contract W-31109-ENG-38. From 27. symposium on engineering aspects of magnetohydrodynamics (SEAM); Reno, NV (USA); 27-29 Jun 1989. Order Number DE89015138/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A novel concept is proposed in which a CO_2/O_2 mixture is used instead of O_2-enriched air as the oxidizer stream for burning coal in magnetohydrodynamic (MHD) electric power generation. When coal is burned with a CO_2/O_2 oxidizer,the principal gaseous products are approximately 92% CO_2, 5% H_2O, and 3% O_2. Obtaining a high-purity CO_2 stream from these combustion products is relatively easy compared to that from a conventional flue-gas stream, which contains only about 15% CO_2. A portion of the high-purity CO_2 stream would be recycled and mixed with O_2 (from an air separation unit); the remainder of the CO_2 could be processed and sold. The CO_2 MHD system would be approximately 3% less efficient than an O_2-enriched MHD system with the same thermal input. However, costs associated with the CO_2 system would be lower, principally because of elimination of NO_x decomposition equipment and reduced steam generator costs due to lower volumetric flue-gas glow rates. This report describes the CO_2 MHD concept and provides a first-order evaluation of performance. Costs are also discussed. 35 refs., 4 figs., 4 tabs.

38643 (CONF-890671–2) **Corrosion behavior of materials for MHD steam bottoming plant.** Natesan, K.; Swift, W.M. Argonne National Lab., IL (USA). Apr 1989. 38p. Sponsored by DOE Fossil Energy. DOE Contract W-31109-ENG-38. From 27. symposium on engineering aspects of magnetohydrodynamics (SEAM); Reno, NV (USA); 27-29 Jun 1989. Order Number DE89015132/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Test data have been developed for the corrosion of several commercial ASME-coded alloys and their weldments by exposing internally cooled ring specimens to simulated MHD environments. The specimens, coated with a K_2SO_4-rich deposit, were exposed for times up to 2000 h at metal temperatures of 762,593, and 567°C to simulate intermediate-temperature air heater (ITAH), transition region and secondary superheater (SSH) conditions, respectively. This report discusses the observed corrosion scale morphologies of various exposed specimens. Data on scale thickness, depth of intergranular penetration, and metal recession are presented and the results are used to assess the corrosion behavior of various materials for application in the MHD steam bottoming plant. 9 refs., 14 figs., 4 tabs.

38644 (CONF-890815–6) **Evaluation of materials for the MHD steam bottoming plant.** Natesan, K.; Swift, W.M. Argonne National Lab., IL (USA). May 1989. 8p. Sponsored by DOE Fossil Energy. DOE Contract W-31109-ENG-38. From 24. intersociety energy conversion engineering conference; Washington, DC, USA; 7-12 Aug 1989. Order Number DE89013304/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Test data have been obtained on the corrosion of several commercial ASME-coded alloys and their weldments by exposing internally cooled ring specimens to simulated magnetohydrodynamics (MHD) environments. The specimens, coated with a K_2SO_4-rich deposit, were exposed for times up to 2000 h at metal temperatures of 762, 593, and 567°C to simulated MHD conditions for the intermediate-temperature air heater (ITAH), ITAH transition region (transition from a low- to medium-chromium alloy to a high-chromium steel), and secondary superheater (SSH), respectively. This paper discusses, in detail, the observed corrosion scale morphologies of various exposed specimens. Data on scale thickness, depth of intergranular penetration, and metal recession are presented, and the results are used to assess the corrosion behavior of various materials for application in the MHD steam bottoming plant. 6 refs., 7 figs., 3 tabs.

38645 (DOE/PC/79674–T1) **MHD channel slag characterization: Final report.** Pollina, R.J.; Rosa, R.J.; Farrar, L.C. Montec Associates, Inc., Butte, MT (USA). Apr 1989. 182p. Sponsored by DOE Fossil Energy. DOE Contract FG22-87PC79674. Order Number DE89012447/JAW. Available from NTIS, PC A09/MF A01 - OSTI; GPO Dep.

An exploratory study, supplemented by limited experimental data, is conducted to establish the influence of slag composition on the MHD channel performance. The nature of coal slag in an MHD environment is described and a comparative analysis of coal slag samples – taken from an MHD channel using both Rosebud and Illinois No. 6 coal – are complete. From the results obtained, it is concluded that detailed analysis of the slag composition can be useful in evaluating coal-fired MHD channel performance. Electrical losses of the channel have been coupled to axial current leakage, which to a large extent, are due to the electrical nature of the slag. The slag electrical behavior is dominated by current transport – especially on the cathode wall. The possible role that metallic phases of iron and potassium, in conjunction with percolation with a slag matrix, is introduced as a model to use for the interpretation of slag current leakage mechanisms. An analysis is performed to evaluate the effect of current leakage on power as the channel scale increases. Two types of leakage mechanisms are evaluated and it is found that both scale favorably, but channel power losses resulting from a constant current leakage type of model provides an improved performances over a current slag conductivity type of power loss.

38646 **Anion-exchange resin-based desulfurization process for alkali metal sulfates.** Sheth, A.C. (The Univ. of Tennessee Space Institute, Tullahoma, TN (US)); Jackson, D.M.; Solomon, R.L.; Herrigel, H.R. v.v of 26th symposium on engineering aspects of magnetohydrodynamics. Muehlhauser, J.W. University of Tennessee Space Institute, Tullahoma, TN (1988). (CONF-880647–: 26. symposium on engineering aspects of magnetohydrodynamics, Nashville, TN, USA, 20-22 Jun 1988).

To desulfurize alkali metal sulfates in an aqueous solution, a simple desulfurization concept based on the use of weak base, anion-exchange resin has been developed and experimentally verified at the University of Tennessee Space Institute (UTSI). In comparison to the other currently available options, this concept seems to be economical. Besides using ambient process conditions, it uses commercially available material and demonstrated technology. It can be modified as required to produce either no waste products needing disposal by landfill or innocuous waste materials that are acceptable for landfill. In general, this concept seems to be more attractive than the presently considered seed/sorbent regeneration options.

38647 **A slurry injection system for coal, seed or ash.** Arunkumar, R. (MHD Energy Center, Mississippi State Univ., Mississippi State, MS (US)); Etheridge, J.; Shepard, W.S.; Cook, R.L. v.v of 26th symposium on engineering aspects of magnetohydrodynamics. Muehlhauser, J.W. University of Tennessee Space Institute, Tullahoma, TN (1988). (CONF-880647–: 26. symposium on engineering aspects of magnetohydrodynamics, Nashville, TN, USA, 20-22 Jun 1988).

The MSU-MHD test stand is an oil-fired test facility with capabilities for ash and seed injections. Modifications are under way to

allow the test train to accommodate coal slurry firing in order to better simulate coal slurry firing in order to better simulate coal combustion for the development of intrusive and non-intrusive techniques for the measurement of various gas stream parameters. Originally an auger feed system was used for the dry seed/ash with pneumatic delivery to the fuel system. As with most pneumatic delivery methods carrying abrasive powders, severe problems were encountered, including binding, flow pulsations and inability to make reliable seed/ash flow measurements. In an effort to satisfy requirements for greater ash and seed (K_2SO_4 and K_2CO_3) loadings with increased reliability, the performance of various slurry mixes was investigated. In particular, the paper describes a unique slurry mix for pure ash injection and another for seed (K_2CO_3) injection. In the latter case seed concentrations of up to 66% in the slurry have been obtained.

38648 A nuclear powered space based disk MHD power system description and performance assessment. Louis, J.F. (MIT, Cambridge, MA (US)); Holman, R.R. v.v of 26th symposium on engineering aspects of magnetohydrodynamics. Muehlhauser, J.W. University of Tennessee Space Institute, Tullahoma, TN (1988). (CONF-880647–: 26. symposium on engineering aspects of magnetohydrodynamics, Nashville, TN, USA, 20-22 Jun 1988).

A very compact nuclear MHD power system design concept conceived for a space system is described. This open cycle disk-MHD power system with thermal energy provided by a nuclear heat source takes full advantage of the disk's unique capabilities in non-equilibrium, space environment conditions this application provides. This results in a minimum volume, minimum mass system. The nuclear reactor design for the proposed power system was taken directly from the Nulcear Engine Rocket Vehicle Application (NERVA) technology. That technology, intended specifically for space application, has been developed extensively and has been confirmed experimentally. The working fluid is hydrogen seeded with very low (5×10^{-5}) mole fraction cesium.

38649 TRW econoseed process for MHD seed regeneration. Meyers, R.A. (TRW Applied Technology Div., Redondo Beach, CA (US)); Coleman, W.B.; McClanathan, L.C. v.v of 26th symposium on engineering aspects of magnetohydrodynamics. Muehlhauser, J.W. University of Tennessee Space Institute, Tullahoma, TN (1988). (CONF-880647–: 26. symposium on engineering aspects of magnetohydrodynamics, Nashville, TN, USA, 20-22 Jun 1988).

TRW has bench-scale tested (DOE contract no. DE AC22-87-PC79672) its patented Econoseed MHD seed regeneration process which gives a near 100% yield of regenerated potassium seed solution in less than five minutes at 60 - 90^{0}C at ambient pressure by reacting calcium formate with potassium sulfate from the MHD channel. This is without loss to formation of insoluble potassium salts, and is estimated to provide recyclable product at a cost of approximately one-half that of buying replacement potassium seed. Bench-scale data has also been obtained on the sole regeneration feed material, calcium formate, which shows approximately 100% yield over a range of temperature and pressure conditions supporting the assumptions of the process cost analysis.

38650 Recent CDIF experience with combustor injection systems and mass flow measurements. Burkhart, R.T. (MSE, Inc., Butte, MT (US)); Herbst, A.S.; Joyce, J.E.; Lundberg, S.K. v.v of 26th symposium on engineering aspects of magnetohydrodynamics. Muehlhauser, J.W. University of Tennessee Space Institute, Tullahoma, TN (1988). (CONF-880647–: 26. symposium on engineering aspects of magnetohydrodynamics, Nashville, TN, USA, 20-22 Jun 1988).

Recent testing at the U.S. Department of Energy's Component Development and Integration Facility (CDIF) has involved injection of new material into the coal-fired combustor (CFC), modification of injection requirements, observation of CFC standard materials, and the measurement of mass flow. This paper is divided into four sections describing recent work at the CDIF involving these new requirements. The first section of this paper reports the experiences with the injection of dry iron oxide. Information is presented showing the method of injection, and some of the pitfalls associated with this particular system. In the second section, work with the solid suspension injection system is outlined. To date, this system has only been used to inject slurried iron oxide. Experience with this system has shown that at lower flow rates (< 5 lb/min), this method is much more reliable and repeatable than pneumatic injection into an environment such as the CFC. The method for size reduction, and the results obtained, are presented in the third section of this paper. The final section of this paper presents the developmental work associated with an on-line mass flow meter. Up to this time, the various mass flow meters have been used at the CDIF with only marginal success.

38651 Stack gas analysis and carbon balance of the MHD topping cycle at the component development and integration facility. Richards, J.M. (MSE, Inc., Butte, MT (US)); Kujawa, S.T.; Whitworth, C.A.; Tourikis, J.A. v.v of 26th symposium on engineering aspects of magnetohydrodynamics. Muehlhauser, J.W. University of Tennessee Space Institute, Tullahoma, TN (1988). (CONF-880647–: 26. symposium on engineering aspects of magnetohydrodynamics, Nashville, TN, USA, 20-22 Jun 1988).

The analysis and flow rate of the gas existing the MHD subsonic diffuser are required for bottoming cycle design. Continually analyzing the gas for combustion product components provides useful data on combustor operation and MHD system response to both combustor transients and system parameter variations. Also, by accounting for the carbon compounds in the gas, slag and water, a carbon material balance closure estimate can be made. The major conclusions of this study are as follows: 1. Stack gas composition is similar to that expected in the quenched, MHD process gas at the subsonic diffuser exit. 2. As equivalence ratios decrease by increasing coal flow, the carbon closure decreases, suggesting that carbon is lost in solid form (soot). 3. Changes to test train process input conditions within the coal transfer cycle time at the Component Development and Integration Facility (CDIF) may be contributing to erroneous interpretation of data.

38652 A coal flow splitting, control and measurement system for the TRW 50MW$_t$ MHD coal combustor. Pote, B.M. (TRW Space and Technology Group, Redondo Beach, CA (US)). v.v of 26th symposium on engineering aspects of magnetohydrodynamics. Muehlhauser, J.W. University of Tennessee Space Institute, Tullahoma, TN (1988). (CONF-880647–: 26. symposium on engineering aspects of magnetohydrodynamics, Nashville, TN, USA, 20-22 Jun 1988).

The viability of a dual coal feed system for use in conjunction with the TRW 50 MW$_t$ MHD coal combustor has been demonstrated and is described herewith. The coal feed system is comprised of three main components: splitting cone, two phase mass flow sensors and flow control elements. The latter two components are contained within each coal flow line. The system allows the simultaneous metering and control of the individual coal flows to the coal fired precombustor and main fuel burning stage from a single pressurized feed hopper. The system should be capable of actively controlling the coal flow rates anticipated during normal operating cycles and during perturbations caused during startup/shutdown transients. The paper discusses the design and integration of an existing coal handling facility at he TRW Fossil Energy Test Site (FETS), modified for test purposes. The paper further discusses the types of components and control philosophies evaluated.

38653 High performance commercial MHD power. Boulay, R.B. (Gilbert/Commonwealth, Inc., Reading, PA (US)); Weinstein, R.E. v.v of 26th symposium on engineering aspects of magnetohydrodynamics. Muehlhauser, J.W. University of Tennessee Space Institute, Tullahoma, TN (1988). (CONF-880647–: 26. symposium on engineering aspects of magnetohydrodynamics, Nashville, TN, USA, 20-22 Jun 1988).

Two mature commercial magnetohydrodynamic (MHD) electric power plant concepts are presented in this paper. These 1000 MWe coal-fired plants use 3100^{0}F regenerative, direct-fired, air preheaters and high performance MHD generators in combination with both advanced concept and conventional steam bottoming cycles. While such MHD/system cycles may properly be referred to as combined cycles, in this paper the term binary cycle is used to avoid confusion with combustion turbine combined cycles. The MHD/steam binary cycle with the most advanced components is projected to operate at 60.6 percent net plant efficiency, the other at 58.1 percent. A comparably rated supercritical steam plant using today's technology would produce power at 37.4 percent efficiency.

While not the ultimate in efficiency for MHD, binary cycle plants would have low environmental emissions compared to today's power plants, and would provide 60 percent more electric power output from a ton of coal.

3005 Fuel Cells

Refer also to citation(s) 38746

38654 (CONF-890815–5) **Material and fabrication challenges in the development of monolithic solid oxide fuel cells.** Balachandran, U.; Dorris, S.E.; Picciolo, J.J.; Poeppel, R.B.; McPheeters, C.C.; Minh, N.Q. Argonne National Lab., IL (USA). 1989. 26p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract W-31109-ENG-38. From 24. intersociety energy conversion engineering conference; Washington, DC, USA; 7-12 Aug 1989. Order Number DE89012422/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Monolithic solid oxide fuel cells (MSOFCs) are presently under development for a variety of practical applications (e.g., advanced space and aerospace power systems, electric utility power generation). The MSOFC is composed of a honeycomb of very small cells of 1 to 2 mm in diameter. The walls of the honeycomb are formed from thin (25 to 100 μm) ceramic layers of cell components: cathode (Sr-doped $LaMnO_3$), anode (Ni/Y_2O_3-ZrO_2 cermet), electrolyte (Y_2O_3-stabilized ZrO_2), and interconnect (doped $LaCrO_3$) materials. These walls form the passages for fuel and oxidant gases. The MSOFC will convert hydrogen or hydrocarbon fuels to DC power at more than 50% efficiency and can achieve considerably higher energy densities than many other technologies. Successful fabrication of an MSOFC depends on incorporating the materials into a self-supporting structure at a higher sintering temperature. A fabrication scheme for the MSOFC must incorporate each material such that no conditions of any fabrication step will destroy desired material characteristics of any of the component layers. Material characteristics and processing parameters must be tailored and controlled to fabricate the MSOFC with desired properties. This paper discusses material properties, material requirements, and fabrication issues in the development of the MSOFC. 12 refs., 9 figs.

38655 (DOE/MC/24223–2713) **Gas-Cooled Fuel Cell Systems Technology Development Program: Quarterly technical progress report No. 26, March–May 1989.** Feret, J.M. Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Energy Systems Div. Jun 1989. 43p. Sponsored by DOE Fossil Energy. DOE Contract AC21-82MC24223. Order Number DE89000999/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report addresses the fourth logical unit of work of a multiyear program whose overall objective is the development of a gas-cooled phosphoric acid fuel cell (PAFC) for electric utility power plant application. This PAFC Technology Development Program continuation is structured to build upon the current cell technology baseline so as to advance critical component technologies to meet the performance, endurance, reliability and cost goals associated with successful energy service. The primary technical objectives are: Demonstrate performance endurance of current cell technology in 10-cell stacks at 70 psia, 190°C, and 267 mA/cm^2. Select and utilize materials, procedures, and methods that improve cell degradation rate to less than 8 mV/1000 hours. Develop cost effective criteria, processes, and design configurations for stack components. Develop design configuration for multiple stack unit and a single 100 kW size fuel cell stack and attain performance goals. Develop design configuration for a 375 kW fuel cell module and demonstrate by test the average cell beginning-of-use performance objectives. Manufacture four 375 kW fuel cell modules and establish performance characteristics and interactions with other systems in a 1.5 MW pilot power plant. Progress is described. 4 figs., 9 tabs.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

Refer also to citation(s) 38511

3201 Buildings

Refer also to citation(s) 38340, 38350, 38708, 38709, 38712, 38727, 38735, 38738

38656 (CONF-8810398–Summ.) **1988 national weatherization state managers' conference: Final report.** Missouri State Government, Jefferson City, MO (USA). 1988. 56p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG47-88R701091. From National weatherization state manager's conference; St. Louis, MO, USA; 3-6 Oct 1988. Order Number DE89014555/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The 1988 National Weatherization Conference was planned by a committee composed of state and federal staff for their colleagues from around the country. The consensus of planning committee members was that the national conference should be composed of state, local and federal staff from around the country. The weatherization program is the largest single energy conservation program in the country and as such we have a large number of skilled and knowledgeable weatherization professionals. The planning committee formally recognized this and designed the conference as an interactive experience. It is the hope of the committee that the "1988 National Weatherization Conference: Gateway to the Future" was enjoyed and a successful experience which provided participants the opportunity to learn new ideas that help make your program better. The State of Missouri was pleased to serve as the host of this conference. As St. Louis was the Gateway to the west it is our hope and belief that weatherization is one of the gateways to the future. Weatherization is a young and dynamic program; a fact which is reflected in the type of people who work in it and consequently attend these conferences. The ideas that are shared and the enthusiasm which is generated for our profession at conferences like this help guarantee a bright picture for our program. On behalf of the Department of Energy, the 1988 National Conference Planning Committee, the Missouri Association for Community Action and the State of Missouri, thank you for attending the conference. We hope you have some fond memories that will be rekindled by reviewing this report.

38657 (DOE/EIA–0318(86)) **Nonresidential buildings energy consumption survey: Commercial buildings consumption and expenditures 1986.** USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Markets and End Use. 5 May 1989. 376p. Sponsored by DOE Management & Administration. Order Number DE89014829/JAW. Available from NTIS, PC A16/MF A01 - GPO - OSTI; GPO Dep.

Consumption and expenditure statistics from the 1986 Nonresidential Buildings Energy Consumption Survey (NBECS) are presented in this report. The NBECS provides basic statistical information on the consumption of and expenditures for energy in commercial buildings, and on the energy-related characteristics of these buildings. EIA conducts this national sample survey of commercial buildings and their energy suppliers on triennial basis. This survey is the only source of national-level data on commercial building characteristics and energy consumption. A previous report covered the characteristics that affect energy use in the 1986 commercial building stock. This report covers energy consumption and expenditures. Annual consumption and expenditure estimates are provided for electricity, natural gas, fuel oil (including kerosene), propane (and other forms of liquefied petroleum gas), and district heat (steam or hot water from a central plant or utility). These are the principle energy sources for which billing data were collected as part of the NBECS, and are referred to as major fuels in this report. Limited statistics are also presented on district chilled water (from a central plant or utility). For other fuels, such as wood and coal, the use of the fuel in the building was determined, but no billing data were collected.

38658 (DOE/ER/60546–5) **The atmospheric chemistry of Po-218: Final report.** Hopke, P.K. Illinois Univ., Urbana, IL (USA). Inst. of Environmental Studies. 30 Jun 1989. 20p. Sponsored by DOE Energy Research. DOE Contract FG02-87ER60546. Order Number DE89014865/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The chemical and physical properties of ^{218}Po immediately following its formation from ^{222}Rn decay are important in determining its

behavior in indoor atmospheres and plays a major part in determining its potential health effects. In 88% of the decays, a singly charged, positive ion of ^{218}Po is obtained at the end of its recoil path. The neutralization rates for Po-218 by the small ion recombination, electron transfer or electron scavenging mechanisms were previously reported: we are now completing measurements of the small ion recombination rate in high purity gases to determine the negative small ion production rate as a function of the ionization potential of the gas. Our studies have also shown that radiolysis of water vapor by the recoiling Po ion produces high local concentrations of hydroxyl (·OH) radicals. These radicals can lead to oxidation of reactive trace gases and the neutral polonium molecule can become incorporated in ultrafine particles formed by the nucleation of low vapor pressure compounds produced by this radical oxidation process. The hydroxyl radical production rate and the production of particles are currently being studied. 26 refs., 8 figs., 2 tabs.

38659 (DOE/ER/60669–3) **The development and field testing of a system for determination of ultrafine activity particle size distribution and working levels: Final report.** Hopke, P.K. Illinois Univ., Urbana, IL (USA). Inst. of Environmental Studies. 30 Jun 1989. 17p. Sponsored by DOE Energy Research. DOE Contract FG02-88ER60669. Order Number DE89014864/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Recent investigations of radon decay products in indoor air have shown that what has been called the "unattached" fraction is in fact an ultrafine size aerosol with diameters in the range of 0.5 to 10 nm. There are a number of difficulties in characterizing particles in this size range. Classical diffusion batteries using screens with high mesh numbers do not have the resolution to give detailed information for the ultrafine range. The use of single screens of differing mesh numbers (Graded Screen Arrays) either in parallel or in a stacked configuration can be used to provide these results. However, accurately measuring the activity directly attached to the screens is difficult because of the attachment of some activity to the back side of the screen and the distribution of activity around the individual screen wires. A continuous monitoring system that would provide information on both the size and charge distributions on these important size range particles has been constructed and its behavior characterized in the laboratory. It is now ready for field testing, after which it will be available to fully assess the exposure of individuals to radon progeny in the indoor environment. 28 refs., 7 figs, 2 tabs.

38660 (DOE/IR/05106–T69) **Planning for energy efficiency in new commercial buildings.** Deakin, J.F.; O'Sullivan, T. Urban Consortium for Technology Initiatives (USA). Energy Task Force. Feb 1986. 96p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013833/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The project described in this report provides other cities with an example of a city working to develop locally sponsored building energy review procedures. These procedures should result in the construction of new buildings incorporating the most energy efficient design measures. This will provide two specific benefits to San Francisco. First, it will reduce energy consumption in new buildings and will slow down the overall energy growth rate for the City's commercial sector. Over the past five years the growth rate for commercial building electricity use in San Francisco has averaged 5% per year, a rate double that of Citywide growth. This project works toward bringing that growth rate in line with the rest of San Francisco's energy users. In addition, San Francisco has the highest rental costs for commercial space in the nation outside of New York City. Any action that can be taken to reduce energy consumption in a new building will result in lower operating costs throughout its life. Reducing costs that would otherwise be spent on energy frees those resources to be spent on more productive areas of the local economy. 39 refs., 8 figs., 8 tabs.

38661 (DOE/IR/05106–T71) **Central energy systems: Applications to economic development.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Jan 1985. 115p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013835/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The primary purpose of this project was to evaluate and define potential benefits of central energy systems (specifically district heating and cooling) as incentives for private development and to integrate proven benefits with other public and private actions to promote economic development within one or more specific targeted areas within the City of San Antonio. This process required the identification of long-range planning criteria that affect the City's decision to develop a DHC system. A computer-aided energy predesign analysis program was used to assess the costs of a DHC system versus individual building systems. This program can provide a preliminary analysis of the costs for a DHC system to both the City and investors/developers. This report is intended as a guide that provides local governments with: (1) an overview on DHC advantages and disadvantages; (2) the planning steps involved in identification of potential sites for DHC; (3) the regulatory factors involved; (4) the incentive for public/private promotion, development and financing; and (5) the economic cost characteristics of various options for DHC systems. 30 refs., 12 figs., 16 tabs.

38662 (DOE/IR/05106–T72) **On-site cogeneration for office buildings.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Apr 1985. 92p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013836/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The purpose of this project was to investigate the feasibility of alternative means of enhancing the economic attractiveness of cogeneration for use in office buildings. One course of action designed to achieve this end involves directing the exhaust heat of a cogeneration unit through an absorption chiller to produce cooling energy. Thus, the units could be operated more continuously, particularly if thermal storage is incorporated. A second course of action for improving the economics of cogeneration in office buildings involves the sale of the excess cogenerated waste heat. A potential market for this waste heat is a district heating grid, prevalent in the downtown sections of most urban areas in the US. This project defines a realistic means to guide the integration of cogeneration and district heating. The approach adopted to achieve this end involved researching the issues surrounding the integration of on-site cogeneration in downtown commercial office buildings, and performing an energy and economic feasibility analysis for a representative building. The technical, economic and legal issues involved in this type of application were identified and addressed. The research was also intended as a first step toward implementing a pilot project to demonstrate the feasibility of office building cogeneration in San Francisco. 13 refs., 7 figs., 4 tabs.

38663 (DOE/IR/05106–T74) **Technology transfer for residential energy programs in new construction and existing housing: A joint venture between the City of St. Louis and Hennepin County.** Urban Consortium for Technology Initiatives (USA). Energy Task Force; Saint Louis, City of, MO (USA). Energy Management Program. Jul 1987. 34p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013838/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The St. Louis Year VII project built on previous work conducted in St. Louis to demonstrate the technology and financing of superinsulated housing, to implement a full-scale, energy efficient housing program in St. Louis. The project also involved the transfer of elements of the St. Louis program to assist Hennepin County in establishing a program to promote energy efficient new residential construction in Minnesota. During the project, Hennepin County (Minneapolis, Minnesota) presented the results of a performance contracting program implemented in Years V and VI to provide energy retrofit for existing homeowners in Minneapolis. This program has special appeal in St. Louis because of the difficulty in motivating middle-income homeowners to invest in conservation options.

38664 (DOE/IR/05106–T77) **Coordinating preventive maintenance with energy management.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Dec 1984. 91p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013841/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

A comprehensive preventive maintenance program is an essential ingredient in any energy management program for municipal buildings. In fact, as stated in Building Operating Management, "Preventive maintenance offers one of the highest rates of return for any energy management project." Ongoing maintenance of heating, ventilating, and air conditioning (HVAC) and lighting systems and equipment saves not only on energy/operating costs in the short run, but also on capital expenses for system and equipment replacement in the long run. The purpose of this project was to develop on a pilot basis the tools and techniques necessary for the implementation of a preventive maintenance program for city facilities. 10 refs., 4 figs., 1 tab.

38665 (DOE/IR/05106–T82) **Residential space heating with wood: Efficiency and environmental performance.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Dec 1985. 142p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013846/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

Wood and coal burned in fireplaces and stoves contribute substantially to the production of energy in Albuquerque's residential community. The use of these fireplaces and stoves has long been considered a basic right of city residents, and is often seen as an economical and aesthetically pleasing alternative to natural gas and electricity. Unfortunately, these residential combustion units (RCU'S), especially when improperly used, can produce a substantial level of particulate emissions. The use of wood-burning RCU'S in Albuquerque has increased significantly over the past 10 years. This increase, coupled with winter temperature inversions, continues to aggravate the city's air pollution problems. The project described in this report was designed to (1) determine use patterns for RCU'S in the Albuquerque area, (2) define means to increase the efficiency and environmental performance of their combustion processes, and (3) suggest options for public action to improve RCU performance. A range of educational, incentive and regulatory alternatives for such public actions are defined in the report.

38666 (DOE/IR/05106–T96) **Alternative techniques for development of energy efficient residential structures.** Kjelshus, B. Urban Consortium for Technology Initiatives (USA). Energy Task Force. Jul 1986. 77p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013861/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The financial burden of high energy prices in over a decade, especially for low and moderate income families, presented a challenge to construct, rehabilitate, and retrofit residential structures so that energy usage could be markedly reduced. The recent moderation in energy has not altered this challenge. This project defines and demonstrates the technical and economic feasibility of the warm room and superinsulation techniques in the development of energy efficient residential structures. These techniques are applied in three housing situations: Application of the warm room approach in retrofitting five residential houses; New construction application of the superinsulation technology in erecting an earth bermmed house; and Rehabilitation of an older residential structure using the superinsulation technology. Findings of the project analysis will include usage of heating fuel/power, energy savings, cost effectiveness, and indoor air quality testing.

38667 (DOE/IR/05106–T98) **Energy enhancements in new residential construction: Phase 2, A cost-effective approach to increasing energy efficiency.** Brandt, M.K.; Brouwer, L.F. Urban Consortium for Technology Initiatives (USA). Energy Task Force. Mar 1988. 90p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013863/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Although adopting an effective energy code for new home construction is an important first step in achieving energy efficient new housing, that's just the beginning. A home is a system composed of its exterior envelope, mechanical systems and occupants. While energy codes address envelope and mechanical systems technology by establishing materials standards, they less often deal with technique, of how those materials should be used and applied. And the role of occupants in this system is unpredictable. Establishing energy components in building codes begins the process of assuring new homes' energy efficiency. Technical assistance and monitoring of construction techniques, and training of occupants to use their home most effectively, are key companion tasks. The focus in building codes, however, has been on technology rather than technique, that is, on what materials to use, rather than on their careful use and application. The occupant behavior component of the system is impossible to address in building codes. This project addresses both technology and technique from a systems approach. 7 refs.

38668 (DOE/IR/05106–T103) **Conversion to separate electric metering: Guidelines for owners of master-metered multifamily buildings.** Nierenberg, N.; Poteat, C.S. Urban Consortium for Technology Initiatives (USA). Energy Task Force. Feb 1983. 77p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013868/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The purpose of this manual is to provide a guideline for considering the alternatives of conversion from master metering to separate metering for owners of master-metered multifamily buildings. The manual presents information about various conversion options, legal issues, and a financial analysis program designed specifically for the evaluation of separate metering conversion options. Although the manual is directed to owners and managers of master-metered multifamily complexes located in Montgomery County, Maryland, the information presented here should be useful for building owners and managers in other jurisdictions throughout the United States. With the exception of the Legal Issues section, the contents of this manual are relevant to all other jurisdictions. The Legal Issues section presents the laws and regulations concerning conversion to separate metering developed by the State of Maryland and Montgomery County. This section also suggests potential sources for information pertaining to the laws and regulations relating to separate metering conversion for other jurisdictions. The financial analysis program is available for the Montgomery County Office of Environmental and Energy Planning, as noted on the final page of this report. 6 refs., 1 fig., 9 tabs.

38669 (DOE/IR/05106–T108) **Technology transfer for residential energy efficiency: Phase 1: Planning the "House-As-A-System".** Miller, R.D.; Martin, C.S. Urban Consortium for Technology Initiatives (USA). Energy Task Force. Jul 1987. 60p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89015417/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This project defined a different approach to producing energy-efficient housing and designed a means for measuring the effectiveness of that approach. Several builders have agreed to modify their housing programs to incorporate the concept of the house as a system on a demonstration basis. A consulting firm has been retained to develop and analyze alternative envelope and mechanical designs, and builders have been recruited to provide houses for the control group. This report describes the initial, first year phase of the project. It covers the redirection of the project to focus on a "systems" approach to residential energy efficiency, includes the revised research design, and presents lessons learned during the planning process.

38670 (DOE/IR/05106–T110) **Neighborhood energy efficiency and reinvestment.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Jan 1987. 86p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89015419/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This project involved the development of a "Neighborhood Energy Efficiency and Reinvestment Concept Plan" to promote residential energy efficiency in San Antonio. The "Neighborhood Energy Plan" concept involved coordinating several technical, organizational and marketing tasks. A neighborhood housing stock evaluation was conducted to determine a "best-set" of cost effective energy conservation measures for San Antonio homes. The results were then presented in the form of "Home Energy Guidelines" that were designed to match specific local neighborhoods. Each guideline described homes similar to those found in the neighborhood and listed the estimated cost and savings for selected energy conservation measures. Concurrently, a videotaped "how-to"series on energy conservation was also produced with the cooperation of various City

agencies and neighborhood associations to provide energy efficiency. During the past three years the City of San Antonio, through its municipally owned utility, City Public Service, has implemented a number of energy conservation programs for the single-family residential market. These programs have included a rebate on the purchase of energy efficient air conditioners, low interest loans, home audits, and free "weatherization" kits. However, the economic and social impacts of these residential energy programs are largely unknown. 19 refs., 7 figs., 5 tabs.

38671 (DOE/IR/05106–T113) **The rehabilitation and retrofit of older houses to superinsulation standards: The superinsulation retrofit.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Aug 1985. 73p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89015422/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

One of the most critical elements affecting this country's economic stability is its dependence on energy from foreign sources. With energy prices rising faster than general inflation, this dependence means a continually increasing drain of dollars from our economy. A significant portion of this country's energy is consumed in the heating and cooling of homes. One of the reasons for this is that the majority of the existing homes were constructed during an era of relatively abundant and inexpensive energy, and they were therefore built without regard for energy efficiency. To the extent that excessive energy consumption at the residential level can be reduced by more efficient use will be of significant benefit to our future economic stability. An obvious way to reduce energy consumption is to simply turn the home's thermostat down during the winter and up during the summer. However, this method not only sacrifices occupant comfort to gain fuel economy, but it also fails to address the home's basic energy-efficiency problems that are the very cause of its high fuel consumption. Superinsulation is one way to reduce energy consumption and, at the same time, increase occupant comfort. The research objective of this project was therefore to demonstrate that energy consumption can be greatly reduced by retrofitting older single family homes to superinsulation standards. 10 figs.

38672 (DOE/IR/05106–T115) **Balancing single pipe steam heating systems: An opportunity for energy conservation in the multi-family market.** Williams, C.H.; Swenson, J.L. Urban Consortium for Technology Initiatives (USA). Energy Task Force. Oct 1987. 129p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89015424/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

This report describes the development and implementation of a demonstration methodology used to test heat balancing for its commercial marketability as a energy conservation service. Chapter 2 provides a context for the project, summarizing the role of energy efficiency in Chicago's multi-family housing stock and the complex of potential conservation strategies. Chapter 3 provides a technical background to the demonstration project with an analysis of single pipe steam heating systems. Chapter 4 describes the design and implementation of the demonstration project. Chapter 5 presents the findings and conclusions resulting from the technical and financial analysis. Chapter 6 summarizes significant lessons learned during the project and presents recommendations for other cities which may want to promote this technique. 2 figs., 6 tabs.

38673 (DOE/IR/05106–T117) **HVAC equipment replacement for best size and efficiency.** Teji, D.S. Urban Consortium for Technology Initiatives (USA). Energy Task Force. Feb 1988. 83p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89015426/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The purpose of this project was to explore the potential benefits of HVAC equipment replacement for buildings owned by the City of Phoenix. The specific research objectives were as follows: Establishment an understanding of the magnitude and sources of saving available through equipment replacement; Establish an economic model for understanding equipment replacement and deciding when equipment should be replaced; Establish technical methods for calculating savings from replacement of various types of equipment; Demonstrate the replacement of a major item of HVAC equipment and document the savings through actual experimentation and measurement; and Provide guidance material for other jurisdictions wishing to investigate equipment replacement. 11 figs., 9 tabs.

38674 (DOE/IR/05106–T118) **Capacity optimization of hydronic flows: Energy savings in HVAC systems.** Teji, D.S. Urban Consortium for Technology Initiatives (USA). Energy Task Force; Phoenix Public Works Dept., AZ (USA). Jan 1985. 100p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89015427/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The purpose of this project was to develop a system that optimizes the use of energy in the hot and chilled water pumping for the HVAC system to use only that amount of energy required to meet heating and cooling needs. The new concept was developed through extensive research, experimentation and pilot implementation of water pumping and temperature control in HVAC hydronic systems. 3 refs., 12 figs., 2 tabs.

38675 (DOE/IR/05106–T125) **A development strategy for superinsulated housing.** Urban Consortium for Technology Initiatives (USA). Energy Task Force; Saint Louis, City of, MO (USA). Jan 1985. 87p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89015434/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This project addressed the problem of introducing radically new construction principles into the residential development arena in the City Of Saint Louis which targeted substantial reductions in heating and cooling costs. Specifically, the goal was to devise a program that could explore the use of "superinsulation" as standard practice in the housing industry, both for new construction and rehabilitation. This meant that major barriers in education, design capability, financing, and technology calibration had to be overcome. The basic approach was to implement a demonstration program that would produce a number of superinsulated housing units of a variety of types. These units would, in effect, be the "test cases" to adapt Canadian and European superinsulation standards to a midwestern United States climate. Subsequent monitoring of these units for actual energy use would "prove" the reliability and high cost-effectiveness of the technology. 31 tabs.

38676 (DOE/IR/05106–T130) **Microcomputer tools for transportation and residential energy conservation: A technical report, Volume 1.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Dec 1982. 89p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89015439/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Both the transportation and residential building elements of the project have the same two purposes. Their first purpose is to develop computer software for use on low-cost microcomputer systems that analyzes the energy impacts of land use and building design decisions, resulting in better knowledge of energy costs available to developers, homebuilders and consumers, thereby fostering more energy-conscious markets. Their second purpose is to augment King County's ongoing land use planning and construction code administration activities by providing better, faster information on energy conservation to County elected officials, staff and citizens. 20 refs., 10 figs., 12 tabs.

38677 (DOE/IR/05106–T131) **Microcomputer tools for transportation and residential energy conservation: A technical report: Volume 2, User's guide and program listings.** Urban Consortium for Technology Initiatives (USA). Energy Task Force; King County Dept. of Planning and Community Development, WA (USA). Dec 1982. 92p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89015440/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This volume is a user guide and program listing of computer codes used for transportation fuel consumption and residential energy conservation. (JEF)

38678 (LBL–20096) **A theoretical convective-transport model of indoor radon decay products.** Schiller, G.E. Lawrence Berkeley Lab., CA (USA). c Apr 1989. 142p. Sponsored by

DOE/CE;DOE/ER. DOE Contract AC03-76SF00098. Order Number DE89014892/JAW. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

A numerical model is developed which is capable of simulating the generation, convective and diffusive transport, and removal mechanisms of radon and radon decay products (daughters). The model is based on fundamental mass-transport equations. Specifically, separate differential equations describe the spatially-dependent concentrations of both unattached (free) daughters and daughters attached to airborne aerosols; the equations are coupled through source and sink terms which include the radioactive decay rate, attachment rate, and recoil factor. Surface deposition of airborne daughters by molecular diffusion is accounted for through boundary conditions. The mass-transport model is employed to examine the influence of key parameters on free and attached deposition rates of the first three radon daughters, with a particular emphasis on the first free daughter, ^{218}Po. These parameters – free daughter diffusivity, aerosol particle concentration, and convective air motion – provide a partial description of the physical and environmental conditions which are likely to have the greatest influence on deposition rates. The effects of air motion on the transport and deposition of radon daughters are examined for laminar, buoyancy-driven enclosure flows and for both free and forced convection boundary layer flows.

38679 (PNL–6878-Vol.1) **Recommendations for energy conservation standards for new residential buildings: Volume 1: Text of the standard.** Pacific Northwest Lab., Richland, WA (USA). May 1989. 121p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC06-76RL01830. Order Number DE89014380/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The purpose of this Standard is to provide for the development of requirements for new residential buildings that promote the efficient use of energy within economic constraints and without compromising the comfort and safety of the occupants. 1 fig., 8 tabs.

38680 (PNL–6878-Vol.2) **Recommendations for energy conservation standards for new residential buildings: Volume 2: Automated residential energy standard—user's guide–version 1.1.** Lortz, V.B.; Taylor, Z.T. Pacific Northwest Lab., Richland, WA (USA). May 1989. 89p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC06-76RL01830. Order Number DE89014382/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This report documents the development and testing of a set of recommendations from the American Society of Heating, Refrigeration and Air Conditioning Engineers, Inc. (ASHRAE) Special Projects Committee No. 53, designed to provide the technical foundation for the Congressionally-mandated energy standard for new residential buildings. The recommendations were developed over a 25-month period by a multidisciplinary project team under the management of the DOE and its prime contractor, Pacific Northwest Laboratory (PNL).

38681 (PNL–6878-Vol.4) **Recommendations for energy conservation standards for new residential buildings: Volume 4, Description of the testing process.** Pacific Northwest Lab., Richland, WA (USA). May 1989. 54p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC06-76RL01830. Order Number DE89014383/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This report documents the development and testing of recommendations, from the American Society of Heating, Refrigeration and Air Conditioning Engineers, Inc. (ASHRAE) Special Projects Committee No. 53, designed to provide the technical foundation for the Congressionally-mandated energy standard for new residential buildings. The recommendations were developed over a 25-month period by a multidisciplinary project team, under the management of the US Department of Energy and its prime contractor, Pacific Northwest Laboratory. The report has been issued in four volumes, VOLUME IV - Description of the Testing Process details how the Standard was tested and provides case studies of the possible impact of the Standard in select locations throughout the country. It is supported by a description of the assumptions and input data, and an analysis of the results.

38682 (PNL-SA–16492) **Predictions of thermal comfort and pollutant distributions for a thermostatically-controlled, air-conditioned, partitioned room: Numerical results and enhanced graphical presentation.** White, M.D.; Eyler, L.L. Pacific Northwest Lab., Richland, WA (USA). May 1989. 9p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC06-76RL01830. (CONF-890615–1: Building simulation '89, Vancouver, Canada, 23-24 Jun 1989). Order Number DE89014918/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

An index of local thermal comfort and pollutant distributions have been computed with the TEMPEST computer code, in a transient simulation of an air-conditioned enclosure with an incomplete partition. This complex three-dimensional air conditioning problem included forced ventilation through inlet veins, flow through a partition, remote return air vents, and infiltration source, a pollutant source, and a thermostatically controlled air conditioning system. Five forced ventilation schemes that varied in vent areas and face velocities were simulated. Thermal comfort was modeled as a three-dimensional scalar field dependent on the fluid velocity and temperature fields; where humidity activity levels, and clothing were considered constants. Pollutants transport was incorporated through an additional constituent diffusion equation. Six distinct graphic techniques for the visualization of the three-dimensional data fields of air velocity, temperature, and comfort index were tested. 4 refs., 7 figs., 1 tab.

38683 (PNL-SA–16592) **Audit predictions of commercial lighting and plug loads.** Pratt, R.G. Pacific Northwest Lab., Richland, WA (USA). May 1989. 15p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC06-76RL01830. (CONF-8905177–1: Electric Power Research Institute demand side management conference, Cincinnati, OH, USA, 2-4 May 1989). Order Number DE89014456/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Energy audits may be conducted at low or no cost to point our cost-effective conservation measures that could be adopted by the building owners. Alternatively, evaluating of the level of conservation measures that should be installed at utility expense. The energy and peak load savings resulting from audit programs are influenced by both the rate of adoption and the installed effectiveness of conservation measures recommended by audits. The accuracy of savings predicted by the audits has long been in question, and affects both the rate of adoption (via "word-of-mouth" and media communication of customer satisfaction) as well as the actual benefits to the utility for installed measures. Hence, assessing the accuracy of the audits is an essential element in the implementation and evaluation of effective audit programs designed to utilize the conservation resource. This paper presents an end-use view of audit accuracy for lighting and plug loads. Other analysis of the data from the overall building point of view has been conducted elsewhere. 3 refs., 8 figs., 3 tabs.

38684 (PNL-SA–16716) **Expert systems for radon mitigation.** Brambley, M.R.; Hanlon, R.L.; Parker, G.B.; Stratton, R.C. Pacific Northwest Lab., Richland, WA (USA). Jun 1989. 14p. Sponsored by DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-890692–16: 82. Air and Waste Management Association annual meeting and exhibition, Anaheim, CA, USA, 25-30 Jun 1989). Order Number DE89014923/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper is directed to researchers, policy makers, radon mitigators, and others familiar with the indoor radon problem and interested in ensuring that high quality mitigation services are available to the public. Expert systems could multiply current efforts to provide information and training to radon mitigators. They could provide continued assistance to mitigators, long after training courses are completed. Such systems would make state-of-the-art knowledge on radon mitigation, now held by relatively few experts, conveniently available to a much larger number of mitigators. Widespread use would improve the quality of mitigation services generally available. Two prototype expert systems developed at Pacific Northwest Laboratory demonstrate graphically, for a limited subset of radon measurement and mitigation decisions, the potential capabilities of expert systems technology in this field. The systems operate interactively, querying the user for information and providing step-by-step advice on radon measurement and

mitigation. The decisions made by these systems are based on information available in published manuals. A fully implemented system for field use would require considerably more development, involving creating an extensive radon knowledge base in cooperation with leading experts on radon mitigation. 3 refs., 6 figs.

3202 Transportation

Refer also to citation(s) 38447, 38463, 38640, 38676, 38677, 38746, 38748, 38797, 38815

38685 (CONF-8906150–2) **The integrated traffic data system.** Rarhi, Ajay K.; Santiago, A.J.; Valentine, D.E. Oak Ridge National Lab., TN (USA). 1989. 14p. DOE Contract AC05-84OR21400. From 3. international conference on microcomputers in transportation; San Francisco, CA, USA; 21-23 Jun 1989. Order Number DE89014095/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Integrated Traffic Data System (ITDS) is a microcomputer-based system designed to allow traffic engineers to store, maintain and update traffic network information in a centralized data base. This data base can then be used to create input data files for some of the widely used traffic simulation and network signal timing optimization models. This paper describes the evolution of ITDS, the current status of the system, and the development activity currently underway. 5 refs., 1 fig.

38686 (SAND–88-3031C) **A Lambert targeting procedure for rocket systems that lack velocity control.** White, J.E. Sandia National Labs., Albuquerque, NM (USA). 3 Nov 1988. 32p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890818–1-Draft: Guidance, navigation, and control conference, Boston, MA, USA, 14-16 Aug 1989). Order Number DE89004824/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A modified Lambert targeting procedure is described for rocket systems which have multiple stages that are without a velocity control capability. Velocity control is generally mechanized as a thrust cut-off or payload separation system, which can be activated when guidance velocity-to-go requirements have been satisfied. The Lambert targeting procedure discussed in this paper is generally based upon accepted and proven Lambert targeting techniques, but is modified to compensate for the lack of velocity control. In particular, the modified Lambert procedure uses an outer-loop iterative process to constrain the magnitude of the Lambert required velocity-to-go to that of the nominal delta-velocity capability of the rocket motor by allowing a variable time-of-transfer. The resulting algorithm effectively compensates for positron errors caused by the boost stages, while limiting errors at the target to those due to off-nominal performance of the Lambert targeted final stage. The details of the modified Lambert procedure are described, and simulation results for several trajectories are presented. The computation requirements of this targeting scheme on the Sandia Airborne Computer (SANDAC) are also discussed. 8 refs., 6 figs., 3 tabs.

38687 (SAND–89-1598C) **A simplified sizing and mass model for axial flow turbines.** Hudson, S.L. Sandia National Labs., Albuquerque, NM (USA). 1989. 6p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890815–16: 24. intersociety energy conversion engineering conference, Washington, DC, USA, 7-12 Aug 1989). Order Number DE89014131/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

An axial flow turbine mass model has been developed and used to study axial flow turbines for space power systems. Hydrogen, helium-xenon, hydrogen-water vapor, air, and potassium vapor working fluids have been investigated to date. The impact of construction material, inlet temperature, rotational speed, pressure ratio, and power level on turbine mass and volume has been analyzed. This paper presents the turbine model description and results of parametric studies showing general design trends characteristic of any axial flow machine. Also, a comparison of axial flow turbine designs using helium-xenon mixtures and potassium vapor working fluids, which are used in Brayton and Rankine space power systems, respectively, is presented. 9 refs., 4 figs., 2 tabs.

38688 (UCRL–101139) **Pulsed laser propulsion for low cost, high volume launch to orbit.** Kare, J. Lawrence Livermore National Lab., CA (USA). 2 Jun 1989. 6p. Sponsored by DOE Management & Administration. DOE Contract W-7405-ENG-48. (CONF-8906169–1: International Astronautics Federation conference on space power, Cleveland, OH, USA, 5-7 Jun 1989). Order Number DE89014049/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Pulsed laser propulsion offers the prospect of delivering high thrust at high specific impulse (500-1000 seconds) from a very simple thruster, using the energy of a remote ground-based laser to heat an inert propellant. Current analyses indicate that payloads of approximately 1 kg per megawatt of average laser power can be launched at a rate of one payload every 15 minutes and a marginal cost of $20 to $200 per kg. A 20 MW entry-level launch system could be built using current technology at a cost of $500 million or less; it would be capable of placing 600 tons per year into LEO. The SDIO Laser Propulsion Program has been developing the technology for such a launch system since 1987. The program has conducted theoretical and experimental research on a particular class of laser-driven thruster, the planar double-pulse LSD-wave thruster, which could be used for a near-term launcher. The double-pulse thruster offers several advantages, including extreme simplicity, design flexibility, and the ability to guide a vehicle remotely by precise control of the laser beam. Small-scale experiments have demonstrated the operation of this thruster at a specific impulse of 600 seconds and 10% efficiency; larger experiments now under way are expected to increase this to at least 20% efficiency. Systems-level issues, from guidance and tracking to possible unique applications, have also been considered and will be briefly discussed. There appear to be no fundamental obstacles to creating, in the next five to ten years, a new low-cost "pipe-line to space." 7 refs., 2 figs., 1 tab.

3203 Industry and Agriculture

Refer also to citation(s) 37961, 37975, 38273, 38290, 38291, 38646, 38662, 38701, 38716, 38844, 38945

38689 (AOSTRA–1988, pp. 20) **Overall site optimization for tar sands facility.** Rutkonski, M.A. (Linnhoff March, Inc., Leesburg, VA, USA); Eastwood, A.R. Alberta Oil Sands Technology and Research Authority, Edmonton, AB (Canada). 1988. (CONF-880807–: 4. UNITAR/UNDP international conference on heavy crude and tar sands, Edmonton, Canada, 7-12 Aug 1988;CE–02661). In *UNITAR/UNDP 4th international conference on heavy crude & tar sands, vol. 5.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $150.00 CAN.

A study was conducted to examine the proposed expansion of the oil sand upgrading facility at Fort McMurray, Alberta. The process units studied were as follows: the hydroprocessor used to crack the bitumen; the diluent recovery unit; the light gas oil hydrotreater; the naphtha hydrotreater; and the hydrogen plant. The overall site heat and power system was also included in the study. The main objective was to audit the contractors' designs, and to determine the optimum utility configuration to handle the complex heat and power demands on the site. Process integration techniques were used to trace energy flows within the various plant processes, recover the optimum amount of waste heat, and to identify process modifications which would have a favorable effect on energy and/or capital costs. The technique employs the concept of composite heating and cooling curves, generated by combining all the heating loads within a given temperature interval into the cold composite curve and the cooling loads into the hot composite curve. The relationship of these two curves helps the designer identify the most constrained part of the process, to permit computation of minimum hot and cold utility requirements, to accomplish the desired processes, and to analyze the process/utility interface. The total site analysis was carried out by combining the detailed information on the expansion plans with information on the existing plants. The alternatives of new boilers, gas turbine integration, and steam turbines were examined. The study of the process units identified opportunities for $5 million in capital cost savings and $1 million per year in energy cost savings. 5 refs., 21 figs.

38690 (DOE/EIA–0306) **Methodological report on the 1980 manufacturing industries survey of large combustors (EIA-463).** USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Markets and End Use. Mar 1982. 72p. Sponsored by DOE Management & Administration. Order Number DE89014990/JAW. Available from NTIS, PC A04/MF A01 - GPO - OSTI; GPO Dep.

The 1980 Manufacturing Industries Energy Consumption Study and Survey of Large Combustors (EIA-463) was designed to collect information on large combustors in the United States and the manufacturing establishments operating them. The survey was mailed to a list of respondents in late November and early December 1980. On February 20, 1981, the Secretary of Energy received notice from the Office of Management and Budget that authority for this information collection activity had been withdrawn and that the information already collected must be treated in a confidential manner. At that time, responses had been received from approximately 76 percent of the final survey frame and, even though this represented a respectable response rate, the usefulness of the survey was substantially disminished. This report presents a detailed overview of the methodology for this survey and a discussion of its limitations. This report is technical and is designed for analysts working with the results of this survey and for survey statisticians interested in specific survey methodologies.

38691 (DOE/EIA–0498) **The relationship between electricity demand and the business cycle, 1969–1985.** USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Markets and End Use. 12 Sep 1986. 32p. Sponsored by DOE Management & Administration. Order Number DE89014979/JAW. Available from NTIS, PC A03/MF A01 - GPO - OSTI; GPO Dep.

This analysis examines the relationship between changes in electricity demand and changes in economic growth and concludes that there is no strong, consistent lead or lag pattern between these two variables. Weak evidence exists that changes in electricity use, in some cases, may have occurred prior to changes in economic activity, although this result was not discovered in all business cycles examined. Other factors including inventory behavior and capacity utilization may have little observable effect in delaying or accelerating electricity use. Based on a lack of compelling evidence, therefore, changes in electricity demand most likely are concurrent with changes in economic activity. Total electricity demand was noticeably affected only during the most recent business cycle. The drop in electricity use during that cycle (September 1981 through December 1985) was attributed largely to a decline in industrial electricity demand, the consequence of a severe drop in output from major electricity-intensive industries. Industrial electricity sales continue to be depressed because these cyclical industries have not yet experienced the recovery seen in other areas of the economy. Whether or not these industries do recover could affect the future electricity/GNP ratio and the nature of changes in electricity demand during business cycles. 11 figs., 10 tabs.

38692 (DOE/EIA–MDR-0269) **Documentation of model changes leading to MEMM 78.1: Model documentation report, February 1980.** USDOE Energy Information Administration, Washington, DC (USA). 12 Mar 1981. 26p. Sponsored by DOE Management & Administration. Order Number DE89014997/JAW. Available from NTIS, PC A03/MF A01 - GPO - OSTI; GPO Dep.

This report describes several changes made to the Midterm Energy Market Model Version 78.0 (MEMM 78.0) since the version used for the 1978 Annual Report to Congress. The major change is the inclusion of the integrated boiler model in MEMM. There are also minor changes in structure and assumptions. This report first describes how the integrated boiler model was included in the Midterm Energy Forecasting System (MEFS). Then, the minor changes are enumerated. The report concludes with a comparison of the MEMM 78.1 forecast with the C-High forecast from the 1978 Annual Report to Congress. 8 refs., 2 figs., 5 tabs.

38693 (EC–E40-11/3-1988, pp. 61-68) **Waste minimization audits.** Cahill, L.B. (HART Environmental Management Corp., NJ, USA). Environment Canada, Ottawa, ON (Canada). 1988. (CONF-8810394–: 10. Canadian waste management conference, Winnipeg, Canada, 25-27 Oct 1988;MICROLOG–89-01998). In *Proceedings of the 10th Canadian waste management conference.* Available from Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The use of waste minimization audits in industry is reviewed and contrasted with traditional environmental audits. In the audits, high priority waste streams are identified through a review of documents, discussions with site staff, and an inspection of the site. These streams are typically ranked and analyzed for potential reduction strategies, such as material substitution, recycling, material conservation, and process modifications. Where potential strategies are identified, a detailed study is made of the costs and benefits, including the concerns of the purchasing, manufacturing, and sales departments. Changes are then recommended which incorporate use of equivalent and readily available materials and processes, which do not substantially affect the quality of the product or the cost of manufacture, including the cost of waste disposal. 8 refs.

38694 (EC–E40-11/3-1988, pp. 69-77) **The role of the waste exchange in waste minimization.** Laughlin, B. (Ontario Research Foundation, Mississauga, ON, Canada); Varangu, L. Environment Canada, Ottawa, ON (Canada). 1988. (CONF-8810394–: 10. Canadian waste management conference, Winnipeg, Canada, 25-27 Oct 1988;MICROLOG–89-01998). In *Proceedings of the 10th Canadian waste management conference.* Available from Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A hierarchy of approaches to industrial waste management is discussed, focusing on those relating to waste reduction: abatement, minimization, reuse, and recycling. The rationale for waste minimization is related to legislation affecting waste management practices, economic costs for alternate approaches such as waste disposal or treatment, and preserving a favorable company image. The concept of waste exchanges is introduced as a means for putting into contact the generators of a waste with the potential users of that waste. Waste exchanges also act as information centers on all aspects of waste management. In Canada, a national program was established as the Canadian Waste Materials Exchange (CWME) in 1978. The CWME is funded by industry and the federal government (ca 30% each) and 40% by the provincial governments. Since 1984, a number of regional exchanges, all linked to CWME, have also been established. As of 1988, there were 3500 participating companies, transferring 320,500 tons of waste per year having a value of $11.8 million. Two thirds of the exchanges involve ongoing waste streams, and the wastes are about equally divided between hazardous and non-hazardous varieties. Future directions for the CWME include a furthering of links with waste exchanges in the USA, computerizing waste exchange databases, and technical assistance. There is also an effort to help to act as entrepreneur in waste exchange, in those cases where there is sufficient supply and demand but the waste needs to be processed into some uniform format to be exchangeable. 5 refs. 3 tabs.

38695 (ORNL/FTR–3280) **[To discuss the dissemination of improved energy-efficient cookstoves in Guatemala, Guatemala City, Guatemala, June 5–7, 1989]: Foreign trip report.** Brown, M.A. Oak Ridge National Lab., TN (USA). 12 Jun 1989. 6p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89014870/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Oak Ridge National Laboratory (ORNL) has a subcontract with Meso American Study Center on Appropriate Technology (CEMAT) to undertake a technology transfer project involving improved energy-efficient cookstoves in Guatemala. Meetings were held with Mr. Edgardo Caceres, Executive Director of CEMAT; with members of his staff; and CEMAT's subcontractor, Merca Plan, in order to assess the project's progress.

38696 (PB–89-168579/XAB) **Cutting energy costs: the 1980 yearbook of agriculture.** Hayes, J. Department of Agriculture, Washington, DC (USA). 1980. 407p. Available from NTIS, PC A18/MF A01.

Also available from Supt. of Docs. See also PB–89-168561.

Contents include: agriculture, forestry: (where farm energy goes part one of overview, how to grow crops with less energy, greenhouse production with lower fuel costs, cheaper ways to grow tree fruits and nuts); family living; (a family checklist to conserve energy, fifty ways to save your energy dollars, adjusting our lives to stretch energy, managing your home to save on energy); communities; (communities and energy saving-an overview, set up an energy plan for your community); alternative energy sources; (how much extra energy can farms produce, the abc's of making farm alcohol and gas, ways to burn wood for industrial use, turning farm wastes into usable energy).

3206 Municipalities and Community Systems

Refer also to citation(s) 38470, 38494, 38495, 38664, 38666, 38668, 38669, 38670, 38672, 38691, 38997, 38999

38697 (DOE/EIA–0254) **Validation of the monthly power plant report system.** Oak Ridge National Lab., TN (USA). 5 Dec 1980. 496p. Sponsored by DOE Management & Administration. DOE Contract AC05-84OR21400. Order Number DE89014988/JAW. Available from NTIS, PC A21/MF A01 - GPO - OSTI.

This report presents the results of a validation study of the Department of Energy's principal source of data on electricity generation, the Monthly Power Plant Report System, (FPC Form 4). This information system gathers monthly data on electricity generating capacity, electricity generation, fossil fuel consumption, and fossil fuel stocks for electric utilities within the United States.

38698 (DOE/IR/05106–T55) **District heating marketing: Analysis of a twelve-city survey.** Davis, R.C.; Buckner, S.N. Urban Consortium for Technology Initiatives (USA). Energy Task Force. May 1987. 130p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89014914/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

This report offers a series of marketing recommendations both for steam-based district heating systems and for hot water systems. District heating marketing in the US is still in its infancy, and marketing managers are still learning which strategies and techniques allow them to concentrate their limited marketing resources for maximum effect. In conclusion, survey findings and analysis are applied to the Columbus market for the benefit of potential district heating developers. Responsibility for implementation and oversight of future district heating projects involving the City of Columbus has now been transferred from the Planning Division to the Public Utilities and Aviation Department. It is expected that future district heating projects in Columbus will be wholly developed, financed, and owned by private interests. 6 tabs.

38699 (DOE/IR/05106–T56) **Feasibility of water-based district heating and cooling: An assessment in New York City: Volume 1, Preliminary analysis.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Jan 1985. 95p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89014915/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

It has been suggested that the economics of district heating in New York City could be improved by using hot water, instead of steam, as the medium for distributing heat, and by distributing chilled water for cooling. Water-based district heating systems are widely used in Europe, and on-site water-based heating and cooling are used in many buildings and multi-building complexes in the US. The New York City Energy Office (NYCEO) and Con Edison are conducting a joint study to evaluate the use of water-based technology to provide district heating and cooling service to potential new customers. The approach is presented here for a site-specific study of a water-based district heating and cooling system that may be economically feasible. The first phase of the study was conducted in-house by NYCEO, at low cost. It comprised (1) site inspection, (2) conceptual design, (3) formulation of a scope of work for engineering/economic analysis by a consultant, and (4) consultant selection. These four project elements and the project development methodology are described in this volume. 16 refs., 5 figs., 4 tabs.

38700 (DOE/IR/05106–T57) **Utilization of felled trees as supplemental boiler fuel.** Lederer, C.C.; Schugar, S. Urban Consortium for Technology Initiatives (USA). Energy Task Force. Apr 1983. 29p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013821/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A valuable natural resource, wood, is being generated in tremendous quantities every year in the City of Detroit as a result of the City's obligation to fell and remove dead trees, principally elms. The bulk of this resource, 115,000 tons of wood every year, is presently being burned at the City's public works facilities, serving only to fill the air with smoke. There are a number of ways to use this wood productively instead of wasting it. The purpose of our project was to explore the economic and technical feasibility of using the wood to supplement coal in a type of existing small industrial boiler that normally would not be considered as suitable for burning a coal/wood mixture, the boiler equipped with a single-retort, underfeed coal stoker. 4 figs.

38701 (DOE/IR/05106–T58) **Development of an energy park in Kansas City, Missouri: Issues and implementation options.** Kjelshus, B. Urban Consortium for Technology Initiatives (USA). Energy Task Force. Mar 1984. 97p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013822/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The realization of the direct relationship between energy prices and economic development provides new opportunities for energy management to encourage business and industrial development in an urban economy. One such opportunity is the concept of an energy park, defined as a site for industrial, commercial and residential uses which can share common energy production facilities or otherwise stabilize energy supplies and costs using a variety of approaches. These approaches may be directed toward the development of new energy sources, improved energy conversion technologies or advanced conservation practices, with any approach complemented by energy-efficient site plan layouts. The Kansas City Energy Park project described in this report evaluated the potential for energy management technologies to attract business and industrial development within a well-designed energy park. The process for the project included: an assessment of Kansas City's resources and needs from a general economic development perspective and in relation to the development of one or more energy parks; the identification of sites, technologies, and business and industrial categories most appropriate for consideration for potential energy park development; the development of specific strategy options and planning guidelines for an energy park in Kansas City; and the formulation of a preliminary implementation plan for further action. 4 figs., 5 tabs.

38702 (DOE/IR/05106–T61) **Energy management and technology for urban governments: A program overview of the Energy Task Force of the Urban Consortium, 1979–1985.** Urban Consortium for Technology Initiatives (USA). Energy Task Force; Public Technology, Inc., Washington, DC (USA). Feb 1985. 58p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013825/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This document presents an overview of work conducted by the nation's major urban governments to address their own energy problems. Together, the results from over 100 applied research projects managed by these cities and counties are sound evidence of an increasingly sophisticated capability for effective energy management by qualified local government professionals. Each of the projects described in this overview was an attempt to resolve an energy management need or problem defined by local officials. Program priorities to guide project selection were determined by managers and staff from the 42 cities and urban counties in the membership of the Urban Consortium. Projects to address these priorities and specific energy management needs were selected by the members of the Consortium's Energy Task Force.

38703 (DOE/IR/05106–T62) **Renovation opportunities for steam district heating systems: A decision process in San Francisco.** Urban Consortium for Technology Initiatives (USA).

Energy Task Force. May 1964. 103p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013827/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

Information in this report is arranged to provide a sequential review of the major steps that a city or county should undertake when evaluating the merits of renovating an older steam-based district heating system. Chapter I provides a general overview of district heating systems, and discusses some of the major systems components, requirements and advantages. The section focuses specifically an older steam based systems operating in US cities, and includes a brief history of the development and evolution of these systems, as well as a discussion of some of their problems. A brief description is also provided of state and federal research directed at assisting cities to bring about improvements to these systems. Chapter II outlines procedures for evaluating both the economic and energy efficiency merits of measures designed to renovate old steam-based district heating systems. This chapter presents a six-phased process for identifying, reviewing and evaluating options which could bridge the gap between the real potential for district heating as a preferred energy supply systems for cities and the real problems of existing steam-based system. Chapter III describes the application of the procedure developed in Chapter II to two steam-based district heating systems in San Francisco. These systems provide "textbook" examples of the district heating systems in need of major rehabilitation. Chapter IV concludes with a discussion on lessons learned from the San Francisco case study. Procedures and research methods that were used throughout the project are evaluated for both their overall effectiveness and transferability to other countries. In addition, this chapter suggests methods for adapting San Francisco's project results to the needs of other countries. 11 refs., 8 figs., 13 tabs.

38704 (DOE/IR/05106–T64) **Implementation methods for an integrated energy system.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Sep 1985. 74p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013829/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Based on previous studies, the Stockyards industrial area was found to have a unique combination of existing industries and growth potential to serve as an optimal location for developing an integrated energy system. Therefore, this project focused on the Stockyards and examined different methods that a city government can use to encourage the development of a cogeneration and/or district heating/cooling system at a potentially viable site. The methods described in this report were aimed at investigating and gaining the participation of key actors necessary for implementing an integrated energy system. This project was designed to allow for the continual investigation of opportunities as they developed. This project concentrated on industrial companies in the Stockyards, as the key energy customers for an integrated energy system in the area. A questionnaire and survey procedure were developed to obtain profiles of energy demand and to ascertain the companies' interest in alternative energy technologies. The survey procedure was successful in gaining the interest and cooperation of energy users in the Stockyards. This project also investigated private sector interest in building, owning and/or operating an integrated energy system in the targeted area. Through these efforts, a group of private developers came forward with their plans to build a privately owned and operated resource recovery system in the Stockyards. 3 refs., 3 figs., 3 tabs.

38705 (DOE/IR/05106–T65) **An innovative financing and incentive package to reduce municipal energy consumption: Data needs, administrative procedures, and financing options.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Jan 1984. 73p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013830/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The research performed by the City of New Orleans during this project consisted of four tasks: an analysis of the energy usage of municipal buildings; the development of profile of City operating procedures; the identification and analysis of potential management incentives; and the identification and analysis of potential creative financing methods for capital improvements. As a result of the project described in this report, each City department will receive for the first time, monthly consumption data on buildings within its department using an excess amount of energy. In addition, the Departments of Property Management, Recreation and Welfare (the three departments with maintenance responsibilities), have set up "conservation teams" to make low cost and no cost conservation improvements in City facilities. Also, a stronger role for the Energy Management Task Force is recommended. While the group currently lacks a specific role, it is now recommended that the group review all capital budget requests, monitor the monthly consumption data provided to the departments, and ensure that action is taken by departments in response to the monthly consumption data reports. The final major product of this project is an analysis of creative financing mechanisms for capital improvements. The analysis shows that a shared savings program can produce more benefits than general bond financing of the improvements. The City is currently pursuing such a financing plan. 8 tabs.

38706 (DOE/IR/05106–T66) **District heating in Denmark: Lessons from a technology exchange.** Urban Consortium for Technology Initiatives (USA). Energy Task Force; Public Technology, Inc., Washington, DC (USA). Nov 1986. 74p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013826/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

A study visit of district heating facilities and related equipment manufacturers in Denmark was conducted in August, 1985, at the invitation of the Danish Board of District Heating, with support from the United States Department of Energy. US members of the study team were selected from the staffs of cities and counties participating in the Urban Consortium Energy Task Force program. The visit included tours of municipal district heating systems in the cities of Odense and Copenhagen, as well as equipment manufacturers in Kolding and in Copenhagen. The visit represented the first element in a technology exchange program that included the Danish Board's cosponsorship and participation in seminars and workshops in the United States in October, 1985. This report has been written by Public Technology, Inc., to describe the approaches taken to support district heating in Denmark and to document the experience of the study visit. The report includes questions asked by US participants prior to the visit, their reactions subsequent to the visit, and a summary of the October workshops in Columbus and San Francisco. 3 tabs.

38707 (DOE/IR/05106–T70) **Modular district heating planning as a development tool: A project report.** Davis, R.C. Urban Consortium for Technology Initiatives (USA). Energy Task Force; Columbus Dept. of Development, OH (USA). Div. of Planning. Jun 1986. 119p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013834/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

In 1984, in the city of Columbus, building on the results of previous district heating assessments funded by both the US Department of Housing and Urban Development and the Danish Ministry of Energy, began a survey of the potential for district heating systems in its downtown and riverfront areas. Of particular interest was the potential for refurbishing an old municipal electric plant on the northwest fringe of the downtown as a heat source for a riverfront area targeted for redevelopment. This report describes the background, assumptions, methodology, and conclusions of that assessment. It must be said at the outset that some questions remain unanswered. The scope of the present study did not permit a full engineering evaluations of the state of the equipment at the old Municipal Light Plant and therefore cannot be the sole basis for a recommendation to proceed with a project. 6 figs., 8 tabs.

38708 (DOE/IR/05106–T73) **Energy monitoring and controlling in municipal facilities: System design and assessment.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Aug 1986. 89p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013837/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The District of Columbia government has undertaken a variety of energy conservation initiatives over the past several years to increase energy efficiency while reducing the impact of energy costs on the District's operating budget. While significant energy savings and cost containment have been achieved, the full potential of these efforts has not yet been realized. Energy management and conservation, however, remain major priorities of the administration. The DC Department of Human Services (DHS) was selected by the administration as a pilot agency for modeling a comprehensive approach to energy management due to its diverse operations and because it is the city's largest department. While DHS combines mental health, long-term care, public health, social services and youth training centers into a major network of community services, a significant number of support systems, i.e., motor pools, mechanical operations and maintenance units determine the level of the Department's energy consumption. The first project produced an energy data management system which established a base for comparing energy costs and consumption at various DHS facilities. A more recent project is an exploration into the feasibility of establishing an energy management and controlling system (EMS) at DC Village, one of the District's long-term care facilities. The findings of this feasibility study serve as a basis for replicating EMS's in other DHS facilities as well as in other municipal operations in the District of Columbia government. 3 figs., 8 tabs.

38709 (DOE/IR/05106–T74) **Measures and investment options for community energy conservation: Strategies with a municipally owned utility.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Jan 1986. 118p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013852/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The purpose of this project is to evaluate and determine the costs and benefits of residential energy conservation strategies in San Antonio and their financial impact upon the municipal utility, the ratepayers, and the City. This process requires the identification of energy conservation strategies and their impact on local single family housing kilowatt (KW) and kilowatt-hours (KWH) consumption. The assessment involves the usage of two computer programs to assess energy consumption and to produce dollar costs and savings associated with individual energy conservation measures. The purpose of this assessment is to produce a "best-set" of residential energy conservation and efficiency strategies for the City of San Antonio. This report is intended to provide quantitative data associated with energy conservation strategies and a guide for local governments with: (1) an overview of residential energy conservation programs; (2) the analytical steps involved in identifying cost-effective measures; (3) the load forecast and generation data required; (4) the range of participation levels; and (5) the economic "best-set" options available to the City and the municipal utility. 17 refs., 11 figs., 21 tabs.

38710 (DOE/IR/05106–T75) **Energy Assistance Program Information System (EAPIS): Coordinating residential energy assistance programs.** Daspit, C.; Showalter, M.; Crawford, P. Urban Consortium for Technology Initiatives (USA). Energy Task Force. Dec 1984. 114p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013839/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The impact of sharply higher energy costs on Philadelphia's lower-income households is a major social problem, and has been recognized as a legitimate concern of city government. Within the past three years many new programs have been established to ameliorate this problem – either by helping people directly with their fuel bills, or by improving their dwellings to reduce energy consumption. In the aggregate these programs (and other, pre-existing ones) together provide $30 to $40 million of energy assistance per year. They are managed by eight agencies including state and local government departments, energy utilities, and non-profit corporations. The programs are not centrally managed or closely linked. There is no effective means of matching clients to services, planning the total system, or assessing the impact of its component parts. City government has responded by creating a new Energy Coordinating Agency, which will have some leverage to influence the use and allocation of assistance funds; meanwhile, an Urban Consortium Energy Task Force grant has made it possible to develop an Energy Assistance Program Information System (EAPIS), which will facilitate coordination and provide the necessary information base for planning. EAPIS will generate reports for two basic purposes, "tracking" and "reporting." To make possible these reports, it will eventually include data from each program agency on the services provided to each client or property. In the pilot demonstration phase, which this monograph describes, the system was designed and its capabilities were demonstrated using sample data only. 22 figs.

38711 (DOE/IR/05106–T79) **Integrating energy efficiency into municipal purchasing decisions: Defining the framework.** Scharer, M.; Pratt, D. Urban Consortium for Technology Initiatives (USA). Energy Task Force. May 1988. 94p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013843/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Energy consuming items are routinely purchased by municipal workers for use in their facilities. Promoting the selection of energy efficient items is a potential device to reduce costs of operating municipal governments and to reduce the need for electric utilities to purchase additional generating capacity. Barriers such as insufficient selection criteria, communication inadequacies, and differing management priorities often preclude energy efficiency improvements. The purpose of this project is to develop a method or process that ensures that municipal staff routinely include energy efficiency as a criterion in the selection of energy consuming items. The methodology will be implemented as a pilot project at Seattle City Light (Seattle's municipally owned electric utility). If successful, it will be recommended to the City, and transferred to other jurisdictions nationally via the Urban Consortium. The project will have two phases. This report details Phase I of the project research: municipalities were surveyed nationally to identify methods and procedures which ensure energy efficient procurements, and for barriers to such procurements; City of Seattle purchasing officers and Seattle City Light originators of purchases were interviewed; and publications of associations promoting energy efficiency in procurement were reviewed.

38712 (DOE/IR/05106–T80) **Technology transfer for residential energy programs in new construction and existing housing: A joint venture between the City of St. Louis and Hennepin County.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Jul 1987. 34p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013844/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The St. Louis Year VII project built on previous work conducted in St. Louis to demonstrate the technology and financing of superinsulated housing, to implement a full-scale, energy efficient housing program in St. Louis. The project also involved the transfer of elements of the St. Louis program to assist Hennepin County in establishing a program to promote energy efficient new residential construction in Minnesota. During the project, Hennepin County (Minneapolis, Minnesota) presented the results of a performance contracting program implemented in Years V and VI to provide energy retrofit for existing homeowners in Minneapolis. This program has special appeal in St. Louis because of the difficulty in motivating middle-income homeowners to invest in conservation options.

38713 (DOE/IR/05106–T83) **Disposal techniques with energy recovery for scrapped vehicle tires.** Sladek, T.A.; Demos, E.K. Urban Consortium for Technology Initiatives (USA). Energy Task Force; Denver Dept. of Public Works, CO (USA). Environmental Services Group. Jun 1987. 99p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013847/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The scrap tire disposal problem is serious and widespread. However there are a number of promising management options, especially using the rubber as a supplemental fuel for existing combustors. The most cost-effective approach to dealing with Denver's tire stockpile appears to be shredding to a coarse size range, storing the shreds in a secure area, and marketing the rubber to nearby cement kilns, lime kilns, and boilers. This interim step would greatly

reduce the volume of the pile, facilitate the Superfund evaluation, reduce fire and disease hazards, and simplify subsequent materials handling. Further processing to obtain rubber chips or crumbs may also be practical. However the industry and the markets would have to emerge over time. New power plants or pyrolysis facilities would be impeded by the low energy prices in Denver and the need for elaborate pollution controls. Landfilling could be considered as a last resort. Landfilling costs would be minimized if the tires are shredded. Chapter 2 discusses the tire disposal problem and the general options for tire management. Chapter 3 describes the methodology used to analyze Denver's situation and presents the results and conclusions obtained. This includes evaluation of strategies to implement the more promising resource recovery options in the Denver area. Chapter 4 summarizes the lessons learned and identifies impediments and uncertainties that need to be addressed in any future studies. The Appendix contains additional acknowledgments, a list of references, definitions for the acronyms and units used in the text, the agenda for the tire workshop, and a brief description of a stockpile fire near Denver in June 1987. 111 refs., 6 tabs.

38714 (DOE/IR/05106–T84) **Financial options for neighborhood energy efficiency.** Dreyfuss, P.; Miranti, K.E.; Peterson, J.E.; Payton, J.; Shechter, G. Urban Consortium for Technology Initiatives (USA). Energy Task Force; Kansas City, City of, MO (USA). Mar 1983. 76p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013848/JAW. Available from NTIS, PC A05/MF A01 - OSTI.

One of the major problems facing the residents of Kansas City is the increasing cost of heating their homes. Approximately 95% of Kansas Citians heat their homes with natural gas. With the price of natural gas doubling every two to three years, it has become increasingly important to decrease consumption while increasing efficiency. Compounding this situation for low and moderate income residents is the shrinking availability of public funds for weatherization. If any progress is going to be made on this problem, alternative funding mechanisms will have to be developed. A potential solution to the problem is through development of the Kansas City Home Energy Assistance and Training Program (HEAT). This program addresses the problem on three levels: (1) using neighborhood groups and organizations as a catalyst to reach individual households through community development strategies; (2) providing education and training resources to assist neighborhood groups in the implementation of identified strategies; and (3) developing financial resources and delivery systems to provide financial options for energy efficiency.

38715 (DOE/IR/05106–T85) **The utility handbook: A guide for local governments in dealing with electric and gas utility issues.** Urban Consortium for Technology Initiatives (USA). Energy Task Force; Van Ness, Feldman, Sutcliffe, Curtis and Levenberg, P.C., Washington, DC (USA). 1 Mar 1983. 135p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Available from Van Ness, Feldman, Sutcliffe, Curtis & Levenberg, P.C., 1050 Thomas-Jefferson Street, N.W., Washington, D.C. 20007.

Electric power and natural gas costs are key and growing components both of the municipal budget and of individual consumers' budget. Municipal officials must consider utility costs in budgeting for virtually every service function of local government. Increasing utility rates, combined with local budgets which are fixed or shrinking, mean that costs of utility services will comprise an increasing percentage of municipal expenditures, absent effective action to reduce consumption of rates. Similarly, utility rates are placing greater demands on the financial resources of residential and commercial consumers. This handbook is designed to assist local governments in identifying opportunities which may exist for dealing with rising costs of utility services and to formulate an effective strategy for dealing with electric and gas utilities.

38716 (DOE/IR/05106–T86) **Innovative financing plans for privately owned waste-to-energy facilities: Volume 1, Financial options and analyses.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Dec 1984. 94p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013850/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The primary objective of this project is to focus on innovative financing for large public purpose projects such as the SANDER facility. The focus of this report is on financing a waste-to-energy project, however the information gathered will be useful to many other types of projects. The concept behind this project is that various financing options and plans are available to local government. Public ownership may be most familiar to local government planners. Today, however, tax law allows cash benefits to tax paying corporations for certain types of projects. These tax benefits are so substantial that private firms are often willing to share a portion of these benefits with project proponents. In the case of public purpose projects this sharing of tax benefits may reduce the cost of the project below that of a publicly owned project. This report examines the variety of factors to be analyzed prior to concluding a financing plan. For instance, a public entity should be concerned with the project risks and their assignment between an agency and a corporation. An agency must understand the tax benefits available in order to understand their impact on project economics. Research in this project focused on the factors relative to structuring and comparing various innovative financing plans. A computer model was designed to aid public agencies in evaluating bonding requirements, construction and operating costs, energy revenue, interest costs, tax benefits and effects of inflation on costs. 8 tabs.

38717 (DOE/IR/05106–T87) **Alternative uses for digester methane gas: An analysis of technical and economic feasibility.** Cohen, R.J.; Demos, E.K. Urban Consortium for Technology Initiatives (USA). Energy Task Force; Denver Dept. of Public Works, CO (USA). Dec 1983. 86p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013851/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Approximately 800,000 cu. ft. of digester gas are produced daily at the Denver Northside Primary Sewage Treatment Facility. Each cubic foot of gas contains approximately 630 Btu of energy. The research objective of the study is to identify beneficial uses for the digester gas and develop criteria by which the technical and economic feasibility of each use of digester gas can be evaluated. Each beneficial use was then analyzed to determine its technical and economic feasibility. A gas analysis program was implemented to develop system design criteria. The information in this report is arranged and presented to explain which steps must be taken in order to determine the most efficient method of utilization of digester gas for a specific sewage treatment plant. Chapter Two outlines a brief history of anaerobic digestion and the Denver sewage treatment plants. Chapter Three depicts techniques and methodology used to determine the results of the analysis of alternatives that were performed. Chapter Four includes an economic and technical analysis for three selected digester gas use alternatives. Chapter Five includes a discussion of the results, problems encountered during the project, and future development of the technology and industry in general. 27 refs.

38718 (DOE/IR/05106–T88) **The impact of source separation on municipal waste-to-energy project feasibility.** Gavette, K.B. Urban Consortium for Technology Initiatives (USA). Energy Task Force. [1989]. 70p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013853/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The report is organized to present the methodology, findings, and method of analysis in determining the impact of reducing the waste stream through recycling upon a waste-to-energy plant. The report is organized in the following way: Chapter 2 presents an overview of the problem, the purpose of the study, the objectives and an introduction to some waste-to-energy technologies; Chapter 3 describes the development of the sampling methodology; Chapter 4 discusses the findings of the samples as related to generation rates, composition, moisture content and Btu content; Chapter 5 describes how the findings of the survey sample may be used to determine the effect on energy output of a waste-to-energy plant when various amounts of recyclable goods are removed; Chapter 6 discusses the barriers to implementing a recycling program and task force recommendations regarding implementation of such a

program; and Chapter 7 provides a summary of the report and its uses. 11 refs., 5 figs., 12 tabs.

38719 (DOE/IR/05106–T90) **The hydrate process for waste water treatment plant sludge dewatering: Commercialization assessment.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Dec 1985. 88p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013855/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

More attention is being paid to innovative technologies for sludge dewatering as larger proportions of wastewater treatment plant budgets are going toward the handling, processing, and disposing of sludge. One such process, the clathrate process, has significant attractiveness as an upcoming alternative to conventional sludge dewatering. The clathrate process, utilizing a natural phenomenon, allows crystalline hydrates of water to form in wastewater treatment plant sludge, thereby allowing the water to be removed from the sludge. Higher degrees of water removal are achieved as the hydrating agent (in this case propane) causes lysing of bacterial cell walls, releasing additional water. Total sludge production can be reduced by as much as 50% resulting in an equal amount of cost savings. The clathrate process could save in excess of one-half billion dollars annually if utilized nationwide to reduce sludge production by 50%. This report presents the results from a bench scale, hydrate forming unit. With propane as the hydrating agent and operating in a batch mode, water molecules were removed from sludge as they became bound in the hydrate crystals. This report also gives information on projected cost savings at the Back River Waste Water Treatment Plant, if this process were implemented there, conceptual commercial plant design, and suggestion for further research and application. 4 figs., 7 tabs.

38720 (DOE/IR/05106–T92) **Facilities energy monitoring system, application in a large municipal government.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Feb 1985. 90p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013857/JAW. Available from NTIS, PC A05/MF A01 - OSTI.

The purpose of this project, "Facilities Energy Monitoring System: Application in a Large Municipal Government," was to design, develop and implement a process through which energy management activities could become integrated with local government administrative and budgetary systems. The assumption was made that local government energy demand is created at the department/agency level and, therefore, must be made accountable for its energy consumption and costs. Others given are that (a) energy management must be treated in a comprehensive manner, not as a series of unrelated activities, and (b) energy management must operate within the context of and as an integral component of local governmental administrative policies and fiscal resources management strategies. 3 figs., 6 tabs.

38721 (DOE/IR/05106–T94) **Integrating energy management with economic development.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Feb 1983. 111p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013859/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This report examines options and develops recommendations for integrating energy management approaches and assistance into New York City's economic development process. It is designed to offer guidance to local government officials seeking constructive methods for addressing energy concerns in pursuit of certain economic development goals. An initial emphasis was placed on the three areas of: business energy assistance services; energy efficiency financing utilizing public-private loan and grant mechanisms; and energy conservation services in neighborhood shopping districts targeted for Community Development Block Grant Commercial Revitalization assistance. 6 tabs.

38722 (DOE/IR/05106–T95) **A hydrate process for dewatering sewage sludge: Feasibility and energy resource potential.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Dec 1983. 47p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013860/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Low moisture content wastewater treatment sludge may be utilized as a renewable energy source. Considering the high cost of sludge disposal and the costs for dewatering by conventional means with chemical additives in expensive process equipment, there are great benefits to be gained from improved dewatering technology. This document reports the findings of laboratory investigations on innovative technology for sludge dewatering clathrate (hydrate) formation of water associated with wet sludge. The purposes of the program were to: prove the concept that sludges may be dewatered by forming clathrate (hydrate) compounds of water with organic clathrating agents; and demonstrate that crystalline hydrates of water may be separated from the treated sludge. Both objectives of the program were achieved, thereby demonstrating the technical feasibility of the concept. Based upon the laboratory data obtained, a preliminary conceptual design of a dewatering process plant was produced and preliminary cost savings for the process were derived. Based on the success of this initial bench test of the process, the City of Baltimore will proceed in 1984 to further assess the commercial potential of the process. 15 refs., 5 figs., 7 tabs.

38723 (DOE/IR/05106–T97) **The hidden link: Energy and economic development: Phase II: Marketing and financing strategies for community energy projects.** Public Technology, Inc., Washington, DC (USA). Jan 1989. 91p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013862/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This guidebook presents the experiences of four local governments which used energy management as an economic development tool to retain and attract businesses within city limits, to maintain the viability of urban downtowns, to lower housing costs for the residential sector, and to increase the viability of commercially redeveloped urban areas. The four local governments participating in this project were Hennepin County, Minnesota; Kansas City, Missouri; New York, New York; and San Francisco, California. 46 refs.

38724 (DOE/IR/05106–T100) **Energy financing for local governments, metropolitan Dade County's energy investment fund.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Nov 1983. 91p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013865/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The purpose of this project was to demonstrate that local governments can use "in-house" resources to fund and implement energy capital improvements that will increase operating efficiencies and energy savings in government service and support delivery systems. The specific mechanism used in Dade County was a revolving loan fund of $150,000. Called the Energy Investment Fund, this program became a new part of Dade's Comprehensive Energy Management Strategy. The goals of this strategy are to help county departments use energy more productively and to reduce energy costs. Through the Fund, Dade has invested over $100,000 in a dozen projects ranging in cost from about $1,000 to $15,000 with a projected first year savings of over $70,000. The county has also developed an energy training program for employees and an energy retrofit team for supplementary preventive maintenance in support of Fund projects and other energy-related activities. 14 figs., 4 tabs.

38725 (DOE/IR/05106–T102) **Energy conservation and economic development: Commercial/industrial land use applications.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Jul 1983. 89p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013867/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This report was jointly prepared by the Energy Management and Long Range Planning Divisions of the San Antonio Department of Planning. This work is part of a unit effort, coordinated by the Urban Consortium Energy Task Force, to assess and strengthen the relationship between energy management and local economic development objectives. The report focuses attention on how to improve energy efficiency in commercial and light industrial developments, through land use controls and incentives. The report is

intended to provide local governments with (1) a process to assess their subdivision and zoning regulations in order to determine whether such regulations deter the implementation of known energy-conserving development techniques and (2) recommendations for removal of such impediments. Due to the prescriptive nature of most local land use ordinances and the generic framework of the energy-conserving measures, the process as outlined in this report could be applied to other land uses. In addition, this project attempts to quantify the potential energy saving associated with selected strategies. 42 refs., 2 figs., 11 tabs.

38726 (DOE/IR/05106–T105) **Financial planning for district heating: The Brooklyn Navy Yard project: A project report.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. May 1984. 54p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013870/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Financial planning for the Brooklyn Navy Cogeneration and District Heating Project involved the establishment of three distinct potential markets, a determination of economic feasibility and the development of a financial structure that could accommodate the diverse social objectives of the project and the nature of the markets to be served. The Brooklyn Navy Yard (BNY) is owned by the City of New York (City) and managed by the non-profit Brooklyn Navy Yard Development Corporation for operation as an industrial park. Development of a cogeneration/district heating facility at the Navy Yard was undertaken to meet multiple community and economic development objectives.

38727 (DOE/IR/05106–T106) **High-efficiency gas furnace modification in low-income housing.** Roberts, R.; Daspit, C. Urban Consortium for Technology Initiatives (USA). Energy Task Force; Philadelphia Office of Housing, PA (USA). Apr 1987. 100p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89015415/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Heat Extractors (a direct-contact type of secondary condensing heat exchanger) were installed on the conventional gas hot-air furnaces in 100 "scattered site" rental housing units owned by the Philadelphia Housing Authority. The Heat Extractor is designed to draw off the flue gases which normally would go up the chimney, and condense them on a water spray; the latent heat thus reclaimed is used to raise the temperature of the return air, and the cooled flue gases are vented horizontally. The installed cost was $695 per unit. With funds provided by an Energy Task Force grant, the Energy Unit in the city's Office of Housing analyzed the energy savings achieved in these installations; it evaluated the applicability and cost-effectiveness of the Heat Extractor technology. On the basis of published laboratory studies, project planners expected that gas use for space heating would be reduced by 15 to 30 percent. This would correspond to a total gas savings in the 12- to 24-percent range. The project had three related purposes. The first was to develop a series of routine procedures for analyzing residential energy consumption accurately. The second purpose of the project was to verify the effectiveness of the Heat Extractor, which, if it performed as claimed, could be a treatment of choice in several low-income energy conservation programs. Again assuming that the technology proved cost-effective, the third purpose was to develop suitable plans and guidelines for its use by the city's public housing authority and housing development agency. 12 refs., 6 figs., 4 tabs.

38728 (DOE/IR/05106–T107) **Multi-jurisdictional planning for district heating: A concept plan for a site in Bloomington/Hennepin County, Minnesota.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Dec 1983. 69p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89015416/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The purpose of this project was to prepare a concept plan for a district heating system serving the Airport South area. This plan was designed to address all major institutional issues relevant to the implementation of the district heating system, serve as a public statement outlining the proposed direction of the project effort, and provide the basis for the later development of a formal implementation plan. The responsibility for preparation of the concept plan was assigned to an advisory committee comprised of potential system customers and interested public agency representatives. This report describes this joint Hennepin County/city of Bloomington project: its conceptual origins, its process and highlights, and its results–both expected and unexpected. Particular attention is given to the special multi-jurisdictional characteristics of this project. Also described are recommendations formulated by the advisory committee, including those related to the role of the public sector in system development, the economic feasibility of district heating and the committee's "recommended system". This was a complex project, although not in that regard different from any comparably large district heating planning effort. But despite these complexities, and despite significant revisions in the nature of the system being contemplated, it does currently appear that portions of the Airport South area may be served by district heating as early as 1985. The developments leading to this point and the lessons learned in the process are expected to be of interest and value to others planning similar efforts.

38729 (DOE/IR/05106–T109) **Strategies to improve community energy use practices: An approach for private/public collaboration.** Bardenwerper, W.; Delahanty, D. Urban Consortium for Technology Initiatives (USA). Energy Task Force. Dec 1982. 70p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89015418/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The major goal of this project was to promote energy-use efficiency through public/private sector collaboration. The objectives were to establish a structure for collaborating, to coordinate programs designed to assist the public, to develop a set of realistic strategies which would help citizens to attain a higher degree of energy self-sufficiency, to document the incidence and prevalence of energy related needs, and to seek financing for strategy implementation. The practical benefit to Jefferson County is a mechanism which has the potential to relieve the government of sole responsibility for meeting an acute community problem. It coordinates the efforts of a number of funding sources and directs allocations in a systematic and planned way. The structure also provides an arena for communicating organizational intentions and establishes linkages among various sectors of the community. The lessons learned can assist other local governments in avoiding unnecessary mistakes and will provide guidelines for sharing responsibility for meeting energy-related needs of citizens. 5 refs., 3 figs.

38730 (DOE/IR/05106–T111) **Developing an energy management tracking system: A monitoring technique: A project report.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Dec 1982. 102p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89015420/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

A major management challenge the city of San Jose faced was the tracking of energy-related expenditures. Development of procedures regarding accountability for energy consumption and efficiency improvements was necessary. The approach selected to resolve the problem was the development of an Energy Management Tracking System (EMTS), designed to assemble, consolidate, and centralize the city's diverse energy-related information files. The development of a centralized energy information system has improved the effectiveness of the city's energy management efforts. The work product now developed responds to the needs of management who review and evaluate energy expenditures, line supervisors who receive information on the status of energy consumption reduction efforts, and elected officials who require regular up-dates in order to provide responsible energy leadership. The research performed during the project consisted of four major tasks: an analysis of the types of energy improvement measures to buildings undertaken within municipal operations; a review of the existing computer files pertaining to buildings and their energy-related features; selection and linkage of the computerized data bases to enable the development of the EMTS; and production of energy management reports which furnish cost-avoidance and related energy performance indices. The project has resulted in an information and evaluation system which can be used to improve the management of energy-related expenditures.

As the city's total energy expenditure is more than $16 million dollars (1981-82), achievement of increased control over utility costs is of significant importance. 8 figs., 5 tabs.

38731 (DOE/IR/05106–T119) **Energy cost reduction through wastewater flow equalization.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Aug 1986. 96p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89015428/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Equalization is a procedure in which diurnal flow variation are dampened and constant or nearly constant flow is maintained for treatment. Constant flow requires constant aeration; consequently, less power is required to operate the blower and this reduces the peak demand charges, especially during the period when the electric rates are highest. It further saves energy when the power demand is shifted from peak hours to off-peak hours. The most common equalization method is to build a storage basin for withholding influent for four to five hours during the peak flow and then allowing it to be processed during the low flow period. Constructing an actual equalized basin is beyond the scope of this study. The object of this project is to simulate the equalized flow conditions in one part of the 91st Avenue WWTP directly from the intercepter, or incoming trunk sewer system. The study determined the savings due to reduced aeration and improved secondary clarifier performance. It further detailed the automatic control design, construction and operation costs for the installation of an equalization basin and how to shift some of the peak power demand to off-peak period due to equalized flow. This study will benefit the City in maintaining equalized flow in part of the plant for reduction in aeration cost (and therefore reducing energy costs) and transferring the overflow to other parallel plants for treatment. The project will also be beneficial to other large cities in determining the usage of a large intercepter as storage basin versus in-line equalized basin. 28 figs., 5 tabs.

38732 (DOE/IR/05106–T120) **Thermal storage strategies for energy cost reduction.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Jan 1986. 116p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89015429/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The purpose of this project was to explore the potential benefits of thermal energy storage strategies for buildings owned by the City of Phoenix. The research performed during this project consisted of four primary tasks: a review of the state of the art in thermal storage equipment and control strategies, including both hot and cold storage; a survey of municipal buildings to assess thermal storage opportunities and select a demonstration site; design and installation of a thermal storage system; and monitoring and payback analysis of the thermal storage system. Results of the project indicate that the technology of thermal storage is ready for widespread application. In typical municipal buildings cool storage can save 40–60% of the cost of air-conditioning, when a time-of-use utility rate is in force. Savings for the project installation are projected to be $1650, which is 51% of the existing cost of air-conditioning the building. 14 figs., 7 tabs.

38733 (DOE/IR/05106–T121) **Energy conservation in water treatment: A study of four water treatment plants in Phoenix, Arizona.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Feb 1983. 109p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89015430/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The total annual energy cost for water supply in the city of Phoenix for the fiscal year 1980-81 was $7 million. Of this, energy costs for water treatment for the four water treatment plants serving the city was over 1 Million dollars. The study and research performed under this grant focuses on the energy cost saving opportunities in water treatment. Elements of major energy consuming functions in water treatment include electric motor-driven raw water pumps and treated water booster pumps, and electrical energy consumption from lighting, heating, ventilation, air conditioning and power driven process equipment. The objective of this project was to study the process and equipment used in water treatment, exclusive of booster pumping, and to identify cost saving alternatives. Both the analytical approaches as well as results are transferable to other urban areas. The research plan included the identification and analysis of existing water treatment methods and equipment for possible energy savings. It also included energy audits of building heating, ventilating and air-conditioning (HVAC) and lighting systems to identify energy conservation measures (ECM's). 8 figs., 20 tabs.

38734 (DOE/IR/05106–T122) **A strategic direction for the Urban Consortium Energy Task Force.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Feb 1985. 47p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89015431/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This Strategic Directions report is first and foremost, an internal working document for the members of the Energy Task Force to assess where it has been, where it is now, and where it wants to go. In addition, the Strategic Directions report is designed to assist in technology transfer by providing information about the applied research program of the Energy Task Force to other selected parties. Further, the contents of the report will be useful in developing marketing mechanism for soliciting additional funding support.

38735 (DOE/IR/05106–T124) **Public housing energy efficiency through private financing: A project report.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Dec 1982. 67p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89015433/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This report describes the major elements of a public housing energy management program that was developed for the San Francisco Housing Authority (SFHA). The SFHA has taken steps to increase the energy efficiency of its housing units by using outside financing, including utility loans and cash incentives, micro-utility energy purchase agreements and shared savings arrangements. These investments are expected to reduce the agency's energy expenditures by $250,000 in the first program year. 19 refs., 5 figs., 6 tabs.

38736 (DOE/IR/05106–T126) **Telecommunications in local government: Issues, strategies, and energy management aspects.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Dec 1983. 124p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89015435/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

In cities and counties hard-pressed to maintain revenues and balance budgets, administrators face the problem of how to increase productivity of operations and services while holding the line on costs. The major assertion of this study is that telecommunication and data processing technologies offer perhaps the best opportunities for improving productivity and efficiency in the work of local government. Although the public sector traditionally lags behind the private sector in the adoption of new technologies, opportunities exist for local governments to catch up to the private sector. This project represents a preliminary effort to identify those areas of local government activity that can be benefited by new telecommunication applications. Through this project, the city of Columbus, Ohio has defined ten "strategic application areas" in which new technologies may offer advantages in terms of greater productivity or efficiency. Among these are telephone systems, building-to-building communications, office automation, new cable services, electronic meter reading, and building management systems. Special attention is given to energy management applications of telecommunication technologies. Such applications include electric system management, water processing, building energy management, sewage treatment, and substitution of telecommunications for certain transportation activities. 3 figs., 7 tabs.

38737 (DOE/IR/05106–T127) **Elements of successful energy management: A comparative study of six local governments.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Dec 1982. 107p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89015436/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This study has been written, not as a technical management guide, but rather as an in-depth analysis of successful energy management practices in six local governments. The focus is on administrative efforts necessary to successful energy conservation programs in government buildings and vehicle fleets. A case study approach is used to allow contrasts and comparisons among a select sample of city and county governments. Analysis of the in-house energy management programs in each of the six jurisdictions reveals seven distinct energy management functions: coordinating and organizing; budgeting; monitoring and analysis of energy management information; actuating (or the use of personal influence); providing technical assistance; planning; and setting performance standards for building and fleet operations. Research also indicates that some of these functions may provide more leverage (or power to effect change) than others, depending on commitments made by administrators and political leaders to assure that functions can and will be performed. 6 figs., 2 tabs.

38738 (DOE/IR/05106–T132) **Shared savings and low income homeowners: Results of a demonstration project in Hennepin County.** Miller, R.D.; Ford, J.M. Urban Consortium for Technology Initiatives (USA). Energy Task Force; Hennepin County Office of Planning and Development, MN (USA). Apr 1986. 103p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89015441/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

In 1984 Hennepin County, with financial support from the US Department of Energy and as part of the Year Five energy program of the Urban Consortium's Energy Task Force, initiated a Residential Shared Savings Demonstration Project (RSSDP) for single family homeowners. Shared savings, or performance contracting, occurs when an energy service company (ESCo) finances and installs energy improvements in a customer's property and receives a share of the savings that result over time as their compensation. Chapter 1 of this report provides general background on the project, including a brief description of Hennepin County, the energy environment within which the project was conducted, and the Residential Shared Savings Demonstration Project. Chapter 2 describes the efforts to market the RSSDP to low income homeowners, the results of those efforts and the findings from an extensive market assessment effort. Chapter 3 summarizes the significant lessons learned during the project. 4 figs., 3 tabs.

38739 (EC–E40-11/3-1988) **Proceedings of the 10th Canadian waste management conference.** Environment Canada, Ottawa, ON (Canada). 1988. 375p. (CONF-8810394–: 10. Canadian waste management conference, Winnipeg, Canada, 25-27 Oct 1988;MICROLOG–89-01998). Available from Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This conference presented papers in the field of waste management legislation and programs, waste minimization and recycling, waste treatment and disposal, municipal solid waste incineration, identification and cleanup of residues, ash management in incinerators, and public policy issues. Most of the papers are relevant to Canadian experience. Separate abstracts have been prepared for 12 papers from this conference.

38740 (EC–E40-11/3-1988 vp) **The role of plastics in waste reduction and waste recycling.** Hayter, R. (Society of the Plastics Industry of Canada, Canada). Environment Canada, Ottawa, ON (Canada). 1988. (CONF-8810394–: 10. Canadian waste management conference, Winnipeg, Canada, 25-27 Oct 1988;MICROLOG–89-01998). In *Proceedings of the 10th Canadian waste management conference.* Available from Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Results from other studies are used to show that substituting other kinds of packaging for plastic containers would increase the weight and volume of wastes. There would also be an increase in the energy consumption for manufacturing the packaging and in the cost of packaging. The recycling of plastics found in municipal wastes in Canada is then reviewed, with mention made of a number of successful programs. These include a plastics collection system in Ottawa using trucks which have means for densifying plastic; a joint venture to establish a major facility to handle about 50 million lb/y of recycled plastic bottles; and use of mixed, contaminated plastics in the production of lumber or concrete products. Biodegradable plastics are seen as a threat to expansion of plastics recycling. 1 tab.

38741 (EC–E40-11/3-1988, pp. 33-41) **Manitoba soft drink recycling. A voluntary success story.** Morrison, L. (Manitoba Soft Drink Recycling Inc., Winnipeg, MB, Canada). Environment Canada, Ottawa, ON (Canada). 1988. (CONF-8810394–: 10. Canadian waste management conference, Winnipeg, Canada, 25-27 Oct 1988;MICROLOG–89-01998). In *Proceedings of the 10th Canadian waste management conference.* Available from Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Manitoba Soft Drink Recycling, Inc. (MSDR) is the only voluntary, non-deposit buyback system for recycling used beverage containers in Canada. The program was set up by the beverage industry to collect and recycle aluminum cans and plastic soft drink bottles. A two-tiered collection system has been set up, consisting of redemption centers and mobile recycling units in the first tier, and donation depots set up by nonprofit organizations in those areas not serviced by the first tier. Containers are paid for by a volume-based pricing system. MSDR has been operating for two years; growth rates for return volumes have been increasing steadily, and such growth has not been achieved at the expense of the province's scrap dealers. Redemption rates for aluminium cans were about 22% in the first year. A total of 195,618 kg of aluminum and 54,560 kg of plastic has been recycled since MSDR was started. The program also involves initiatives to increase public awareness by means of specially designed collection bins, promotional materials, and educational activities in the schools. The costs of this voluntary system are compared to those of a deposit system in order to indicate the advantages of the voluntary system. 5 refs., 4 figs.

38742 (EC–E40-11/3-1988, pp. 133-138) **Operating and emission guidelines for municipal solid waste incinerators.** Hay, D.J. (Environment Canada, Canada). Environment Canada, Ottawa, ON (Canada). 1988. (CONF-8810394–: 10. Canadian waste management conference, Winnipeg, Canada, 25-27 Oct 1988;MICROLOG–89-01998). In *Proceedings of the 10th Canadian waste management conference.* Available from Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Energy-from-waste incinerators are being increasingly used in Canada as a solution to the municipal waste problem. However, as many toxic materials can be found in municipal solid wastes, the incinerators must be operated properly to ensure that emissions are free of environmental and health concerns. Recommendations are presented which are considered as minimum requirements applicable to all facilities. These recommendations involve the size of the facility, the combustion technology used, air pollution control systems, stack discharge limits for flue gases, management of ashes and wastewater, monitoring, and general operating procedures.

38743 (EC–E40-11/3-1988, pp. 139-148) **A social benefit-cost analysis framework for analyzing public investments in energy-from-waste facilities.** McDaniels, T.L. (McDaniels Research Ltd.); Swoveland, C. Environment Canada, Ottawa, ON (Canada). 1988. (CONF-8810394–: 10. Canadian waste management conference, Winnipeg, Canada, 25-27 Oct 1988;MICROLOG–89-01998). In *Proceedings of the 10th Canadian waste management conference.* Available from Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The decision to install an energy-from-waste (EFW) facility is complex, not only involving consideration of capital costs and value of energy produced, but also other less-quantifiable costs such as environmental costs. Social benefit-cost analysis is useful in aiding

such a decision. An example is presented of the method adopted in two previous reports, one analyzing hypothetical EFW facilities in 35 locations across Canada and the other examining the social costs of landfills at 6 major Canadian urban areas. The basic approach of the social benefit-cost method is to enumerate, in a manner similar to cash flows, the flow of social benefits and costs over time associated with a given actvity. Discount rates are then used to determine the net present value of the given proposal. For EFW facility, an appropriate approach is from the perspective of the waste management system as a whole, since operation of the facility necessarily requires ongoing operation of a landfill. The total societal cost of refuse disposal, both with and without the EFW facility, is compared; the cost difference indicates the net change in total disposal costs due to construction of the EFW facility. A particularly important component of the analysis is the social cost of landfilling. The direct approach to determine this cost involves examining the effects of currently-operating landfills, such as cost of land and facilities, and estimates of costs to society of the environmental effects of the landfill. In the indirect approach, the costs of building a new, environmentally sound landfill are estimated. The latter approach provides a proxy measure of environmental damage by estimating the cost of preventing such damage, and is favored. 6 refs., 2 figs., 3 tabs.

38744 (EC–E40-11/3-1988, pp. 149-155) **Status of R&D activities in the European economic community.** Van Santen, A. (Environmental Safety Centre, Oxon, UK). Environment Canada, Ottawa, ON (Canada). 1988. (CONF-8810394–: 10. Canadian waste management conference, Winnipeg, Canada, 25-27 Oct 1988;MICROLOG–89-01998). In *Proceedings of the 10th Canadian waste management conference.* Available from Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The status of municipal waste incineration, and alternate methods of waste disposal such as recycling, in the European Economic Community is reviewed. Estimated total of municipal waste produced is 110 million tonnes per year, with about 25% of this waste being incinerated, 5% recycled, and the rest send to landfills. About 525 incinerators are in operation in the Community, with the bulk of the capacity in the larger incinerators. In the 9 years to 1987, 49 research and development projects have been selected for support under the Community's Energy Conservation program under the categories of production of heat and energy by direct combustion of waste, and production and utilization of refuse-derived fuels. Waste sorting research was originally seen as means of recovering valuable components of waste (such as lead from batteries) but is becoming seen more and more as a means of fuel production. Research in reduction of emissions from incinerators is examining alternatives to simple dust removal using cyclones or electrostatic precipitators. 20 refs., 2 figs., 2 tabs.

38745 (ORNL/FTR–3290) **[Workshop on municiple waste combustion, Cincinnati, Ohio, attended by Eros Bacci, University of Siena, Italy, June 6–11, 1989]: Foreign trip report.** Travis, C.C. Oak Ridge National Lab., TN (USA). 27 Jun 1989. 12p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89009036/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Dr. Bacci was supported by the US Environmental Protection Agency (EPA) through an interagency agreement with the Department of Energy (DOE) to participate in a workshop on food chain impacts of municipal waste combustion. The focus of the workshop was on atmospheric deposition modeling, food chain impacts, and uncertainty analysis. Dr. Bacci is a world-recognized expert on foliar uptake of organics by vegetation. He presented measured values for the air-to-vegetation bioconcentration factor for ten organic compounds. His research demonstrated that foliar bioconcentration is a function of both octanol-water partition coefficient and Henry's Law Constant.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

38746 (DOE/IR/05106–T91) **Analysis of municipal bus operations for the advancement of fuel cell technology.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Jun 1985. 94p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89013856/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Several technological and economic advances, however, must be made before fuel cell power plants can be used on the typical municipal bus. Further, it is highly possible that fuel cell-powered buses, representing a radical departure in design and operational needs, will require a different set of skills for the bus maintenance worker. As a joint effort between the city of Albuquerque and the Los Alamos National Laboratory (LANL), this study is a beginning effort to accelerate the use of fuel cell technology in actual bus applications. In recognition of the developing stage of fuel cell technology and its differences from conventional power plants, this study was designed as an initial step necessary to move fuel cell research for buses from the theoretical stages to a more applied setting. The information produced by this project will be valuable to national fuel cell research for buses to verify existing knowledge and extrapolate with relative certainty the performance and operating cost of buses powered by fuel cells. The secondary benefit from this investigation has been the development of improved maintenance and operational data on Albuquerque's city bus system. The methodologies and information produced by this study should be useful not only to the city of Albuquerque and LANL, but to other transit operators and fuel cell researchers. The data will be made available through both the Urban Consortium Energy Task Force, and the vast networking capabilities of LANL. 1 ref., 9 figs., 7 tabs.

3301 Internal Combustion Engines

Refer also to citation(s) 38283

3306 Vehicle Design Factors

Refer also to citation(s) 38464

3308 Alternative Fuels

Refer also to citation(s) 38283, 38284, 38285, 38286

38747 (DOE/IR/05106–T128) **Methanol use in vehicle fleet operations: An analysis of technical and institutional barriers.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Jun 1983. 106p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89015437/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

To reduce the nation's dependence on imported petroleum and to reduce the depletion of non-renewable energy resources, the use of alternative vehicle fuels must be examined. Despite its great promise as an automobile fuel, very few field demonstrations have been conducted using neat methanol, or blends where methanol is the primary component, in vehicle fleet operations. The objectives of this project were to determine the technical reliability and economic feasibility of methanol vehicles, examine institutional barriers to alcohol use as a viable alternative vehicle fuel, and delineate operational barriers in a municipal fleet. Six vehicles were converted to use a blend of 90-volume-percent methanol and 10-volume-percent unleaded gasoline. Precise records were kept of the fuel consumption, maintenance, and reliability/durability of the test vehicles and an equal number of gasoline-fueled control vehicles. A refueling station dedicated to storage and dispensing the methanol fuel was constructed. The reactions and attitudes of the drivers, maintenance personnel, and managers of the project were documented. 20 refs., 7 figs., 12 tabs.

38748 (DOE/IR/05106–T129) **Methanol use in vehicle fleet operations, A comparison of factory-produced vs. converted vehicles.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Oct 1985. 69p. Sponsored by DOE Conservation

& Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89015438/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The objectives of Baltimore's project were to compare the technical reliabilities and operating economics of factory-made methanol vehicles relative to vehicles retrofitted to operate on a methanol/gasoline fuel blend. Since the first published report in June 1983, a significant amount of test data, road experience, and maintenance information have been collected on two distinct sets of methanol fleets, one retrofitted set and one set factory-made to run on methanol. The documentation of these results and analyses can enhance the current body of knowledge on the utilization of methanol fuel and prove an insightful reference guide to present and future operators of methanol fleets. This report has been organized into four substantive chapters which review the rationale for initiating this project and present the operational experiences in a logical manner. Chapter 2 presents background information about methanol (properties, supply, and price projections) and explains how the present project contributed to the current state of the art of methanol as a fleet vehicle fuel. Chapter 3 describes how the project was designed and operated. The results of the project are also presented. Chapter 4 summarizes the comparisons observed between the factory-produced methanol vehicles and the converted methanol vehicles. Suggestions are offered for methanol vehicle purchase by other jurisdictions and what further methanol fleet vehicle research might be conducted. 13 refs., 14 figs., 18 tabs.

35 ARMS CONTROL

38749 (LA–11587) **Strategic defenses and international stability: Report No. 7.** Weltman, J.J. (ed.). Los Alamos National Lab., NM (USA). Nov 1988. 51p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-36. (CNSS–7). Order Number DE89013899/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

These papers grew out a workshop on Strategic Defenses and International Stability held at Los Alamos on October 30, 1987. The workshop was sponsored by the Center for National Security Studies of the Los Alamos National Laboratory. The purpose of the workshop was to present a broad discussion of the relationship between stability and defenses against ballistic missiles. A range of views about the relationship exists in policy circles in the United States and among our allies, and this range was reflected in the presentations by a panel of experts. The term "stability" has a number of specific meanings when used in public discussion of strategic matters. This report first examines these different meanings—deterrence stability, crisis stability, arms control stability, and alliance stability—in the context of historical and contemporary strategic problems. Each member of the panel of experts then, in turn, assesses the effects of strategic defenses on stability for each of the meanings given above.

38750 (NYU–9015489) **American press coverage of US-Soviet relations, the Soviet Union, nuclear weapons, arms control, and national security: A bibliography.** Dorman, W.A.; Manoff, R.K.; Weeks, J. New York Univ., NY (USA). Center for War, Peace, and the News Media. c 1988. 102p. Available from Center for War, Peace, and the News Media, New York University, 10 Washington Place, New York, NY 10003 (8.00).

This bibliography covers work that addresses coverage of nuclear and arms control issues, defense, the Soviet Union, and Soviet-American relations by the American news media between 1965 and 1988. Material selected for inclusion either discusses press performance or addresses conditions – such as classification of information – that directly impact on media coverage of such issues. Bodies of literature on media coverage of conflict elsewhere in the world lie outside the Center's current mandate (which has shaped the parameters of this bibliography) except insofar as such conflicts are presented by the news media specifically in the context of US-Soviet relations. Much the same is true of such issues as the North-South flow of information and the debate over calls for a New World Information Order. However, the authors have decided to include assessments of American media coverage of the Vietnam War as a case study of a watershed conflict that raised many of the issues discussed throughout this literature in a particularly compelling way.

36 MATERIALS

Refer also to citation(s) 38992

3601 Metals and Alloys

Refer also to citation(s) 38112, 38193, 38361, 38369, 38371, 38392, 38643, 38801, 38849, 38853, 38882, 38927, 39700

38751 (CHOA–8709, pp. 7) **Temperature poses unique material challenges for heavy oil operation. Two cases.** Chambers, N.A. (Esso Resources Canada, Ltd., Canada); Chiu, A.S. Canadian Heavy Oil Association (Canada). 1987. (CONF-8709445–: 6. quarterly meeting of the Canadian Heavy Oil Association, Calgary, Canada, 22 Sep 1987;CE–02642). In *Surface facilities optimization program. Proceedings [of the] fifth quarterly meeting of the Canadian Heavy Oil Association.* Available from Alberta Oil Sands Technology and Research Authority, 500 Highfield Pl., 10010-106 St., Edmonton, AB, Canada T5J 3L8; $N/C.

Downhole pump metallurgy is used to illustrate temperature dependent metallurgical phenomena affecting the performance of subsurface sucker rod pumps and fittings. Experience in cyclic steam stimulation at a Cold Lake operation is described, in which it was noted that a number of pump rod failures were attributed to bent barrels. Metallurgical examination and laboratory testing showed that the steam had tempered the internal hardened layer of the steel rod. These findings led to revised specifications for purchase and repair of these items. In addition, this paper documents the use of a high-temperature thermoplastic material as a grid hanger in an electrostatic treater for Cold Lake heavy oil. Each hanger was designed to carry a tensile load of 48 kg at an operating temperature of 110 degrees C. The combination of thermal stability and electrical properties makes fluoropolymers the preferred material for this type of application. Brittle failures of some hangers, leading to grid structure collapse, was investigated. It was found that during the pulsating ram extrusion process used in hanger manufacture, a number of "cold joints" were formed. These were weak links and failed at low stress levels in a brittle manner. By injection molding in the exact lengths required, the cold joints were eliminated and no more brittle failures were reported. Other failures were reported at the hanger connections, and a number of design improvements were suggested in order to match the connection strength with that of the improved hanger body.

38752 (CONF-890842–1) **Applications of ADINA to viscoplastic-dynamic fracture mechanics analysis.** Bass, B.R.; Kenney-Walker, J.; Dickson, T.L.; Pugh, C.E.; Schwartz, C.W.; Thesken, J.C. Oak Ridge National Lab., TN (USA). 1989. 38p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. From 7. ADINA conference; Houston, TX, USA; 2-4 Aug 1989. Order Number DE89006624/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Nonlinear rate-dependent effects in crack run-arrest events in ductile materials are being investigated through development and applications of viscoplastic-dynamic finite element analysis techniques. This paper describes a portion of these studies wherein various viscoplastic constitutive models, dynamic crack-propagation algorithms, and proposed nonlinear fracture criteria have been installed in the general purpose ADINA finite element computer program. The predictive capabilities of the nonlinear techniques are evaluated through analyses of crack-arrest tests of nonisothermal wide-plate specimens. Values of fracture parameters calculated by elastodynamic and viscoplastic dynamic techniques are compared to assess the impact of including viscoplastic effects in the computational models. Mesh refinement studies are presented that examine whether the proposed fracture parameters converge to nonzero values in viscoplastic dynamic analyses or whether they are controlled by element dimensions. Plans are reviewed for additional computational studies to assess the utility of viscoplastic analysis techniques in constructing a dynamic inelastic fracture mechanics model for ductile steels. 26 refs., 8 figs., 4 tabs.

38753 (CONF-890855–1) **Wide-plate crack-arrest tests utilizing prototypical and degraded (simulated) pressure vessel steels.** Naus, D.J.; Keeney-Walker, J.; Bass, B.R.; Fields, R.J.; de-Wit, R.; Low, S.R. III. Oak Ridge National Lab., TN (USA). 1989. 11p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. From 10. international conference on Structural Mechanics in Reactor Technology (SMIRT); Anaheim, CA, USA; 14-18 Aug 1989. Order Number DE89008605/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Sixteen wide-plate crack-arrest tests have been completed, ten utilizing specimens fabricated from A533B class 1 material and six fabricated from a low-upper-shelf base material. Each test utilized a single-edge notched specimen that was subjected to a linear thermal gradient along the plane of crack propagation. Test results exhibit an increase in crack-arrest toughness (K_{Ia}) with temperature, with the rate of increase becoming greater as the temperature increases. When the wide-plate test results are compared with other large-specimen results, the data show a consistent trend in which the K_{Ia} data extend above the limit provided in ASME Section XI. 11 refs., 6 figs., 2 tabs.

38754 (CONF-890855–32) **Radiation-induced temperature shift of thhe ASME K_{Ic} curve.** Nanstad, R.K.; Haggag, F.M.; Iskander, S.K. Oak Ridge National Lab., TN (USA). 1989. 7p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. From 10. international conference on Structural Mechanics in Reactor Technology (SMIRT); Anaheim, CA, USA; 14-18 Aug 1989. Order Number DE89012344/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The objective of this study was to determine the effects of neutron irradiation on the temperature shift and shape of the K_{Ic} curve described in Sect. XI of the ASME Boiler and pressure Vessel Code. Two submerged-arc welds with copper contents of 0.23 and 0.31 wt % were commercially fabricated in 215-mm-thick plate. Charpy impact, tensile, dropweight, and compact specimens up to 203.2 mm thick were fabricated and tested to provide a large data for unirradiated material. Similar specimens with compacts up to 101.6 mm thick, irradiated at about 288°C to a mean fluence of about 1.6×10^{19} neutrons/cm^2 in the Oak Ridge Research Reactor, were tested to provide a similarly large data base with which to evaluate the temperature shift and shape of the ASME K_{Ic} curves. Testing was performed by both Oak Ridge National Laboratory and Materials Engineering Associates. Both linear-elastic and elastic-plastic fracture mechanics techniques were used to analyze test results. 3 refs., 4 figs., 1 tab.

38755 (DOE/ER/45347–13) **Ultrasonic attenuation in heavy fermion superconductors.** Coffey, L. Ohio State Univ., Columbus, OH (USA). Dept. of Physics. 1989. 2p. Sponsored by DOE Energy Research. DOE Contract FG02-88ER45347. (CONF-890718–7: International conference on materials and mechanisms of superconductivity - high-temperature superconductors, Stanford, CA, USA, 23-28 Jul 1989). Order Number DE89014937/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The large effective electron mass in the heavy fermion superconductors UPt_3 and UBe_{13} can produce peaks and other features in the temperature and magnetic field dependent sound attenuation. 4 refs., 3 figs.

38756 (GKSS–88/E/67) **Neutron diffraction texture analysis in extruded Al-Pb composites.** Brokmeier, H.G.; Boecker, W.; Bunge, H.J. GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). 1988. 16p. Contract BMFT 03BU1CLA9. Available from Also published in Textures and Microstructures, by Gordon and Breach Publishers (UK), 1988, v. 8-9, p. 429-441.

The textures of the two phases of Al-Pb composite samples of various compositions extruded 96% at room temperature were determined by neutron diffraction. In both phases the degree of texture decreases with an increase in amount of the other phase. In the case of the harder Al-phase, this is due to the decreasing internal deformation degree of the hard Al-particles in the soft Pb-matrix. In the case of the softer Pb-phase, the decrease must be related to increasing turbulence of flow in the soft phase. Furthermore, this phase was recrystallized after extrusion. (orig.).

38757 (INIS-mf–11440, pp. 351) **On the structure phase transition in liquid sodium.** Padureanu, I.S. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering); Rapeanu, S.N.; Ion, M. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics*. Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Neutron diffraction measurements on liquid Na have been performed at differnt temperatures at VVR-S reactor, IPNE Bucharest. (authors).

38758 (INIS-mf–11480, pp. 15-16) **Theory of superconductivity.** Schachinger, E.; Langmann, E.E.; Pint, W.; Prohammer, M.; Triebelnig, D. Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik. Nov 1988. (In German). In *Annual report of the Institute for Theoretical Physics in Graz, Austria*. Order Number DE89631627/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

FERMI LEVEL/anisotropy; SUPERCONDUCTIVITY/critical field; ALUMINIUM ALLOYS; COPPER OXIDES; ANISOTROPY; GADOLINIUM ALLOYS; IMPURITIES; LANTHANUM ALLOYS; LANTHANUM COMPOUNDS; NIOBIUM; STRONTIUM COMPOUNDS; SUPERCONDUCTIVITY; TEMPERATURE DEPENDENCE; PROGRESS REPORT

38759 (INIS-SU–80, pp. 21-25) **Interaction of positrons with radiation defects and hydrogen atoms in stainless steels.** Silant'ev, V.I. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Metallofiziki); Fedchenko, R.G.; Kolchin, V.A.; Kupchishin, A.I.; Mukashev, K.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *Physics of radiation injuries and radiation materials science. Scientific-technical collection.* Order Number DE89012114/JAW. Available from NTIS (US Sales Only), PC A05/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 3(41).

The effect of low strain fast neutron irradiation ($E \geq 0.1$ MeV, $D=10^{18}$ cm^{-2}) and hydridation on parameters of positron annihilation in 10Kh18N10T, Kh15N28V2M4B and IKh13M2S2 steels is investigated. The process of defect formation at combined effect of hydrogen, stain and irradiation is analysed. By the curves of isochronous annealing. The activation energies of motion of forming defects are determined. 6 refs.; 3 figs.; 1 tab.

38760 (INIS-SU–80, pp. 60-67) **Study on the low-temperature metal blistering by desorption mass spectroscopy.** Budnikov, A.T. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.); Neklyudov, I.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *Physics of radiation injuries and radiation materials science. Scientific-technical collection.* Order Number DE89012114/JAW. Available from NTIS (US Sales Only), PC A05/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 3(41).

Results of complex study on kinetics of forming the low-temperature (T=78 K) blistering during poly- and monocrystalline metal irradiation with E=30 keV H^+ and He^+ ions are presented. Using a high-sensitive mass-spectrometry of partial gas pressure pulsations, evoluted from blisters and microscopic study of targets critical radiation doses are determined, gas pressures in blisters at the stage of their destruction are estimated, a good correlation between the channelled ion path length, blister sizes, pulsation amplitude of partial pressures of evoluted from blisters hydrogen and helium is established. It is shown that sizes, form and density of blisters are much dependent on the type of bombarding ions and irradiated metals. 15 refs.; 8 figs.

38761 (INIS-SU–88) **Physics of radiation damages and radiation science of materials. Scientific-technical collection.** Voprosy atomnoj nauki i tekhniki. no. 4(42). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR).

Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 52p. (In Russian). Order Number DE89012190/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Individual papers in scope for the data base are processed separately. (DLC)

38762 (INIS-SU–88, pp. 3-13) **Gas porosity in metals and alloys irradiated by helium ions.** Kalin, B.A. (Moskovskij Inzhenerno-Fizicheskij Inst., Moscow (USSR)); Korshunov, S.N.; Chernov, I.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *Physics of radiation damages and radiation science of materials. Scientific-technical collection.* Order Number DE89012190/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 4(42).

Experimental studies of the development of gas porosity in metals and alloys during irradiation with helium ions up to high doses and during post-irradiation annealings, are reviewed. The main theoretical problems of the mechanisms of bubble formation and growth, the regularities and peculiarities of bubble development in a thin near-the surface layer during the introduction of helium with the energy of tens of kiloelectron volt, are considered. 60 refs.; 6 figs.; 3 tabs.

38763 (INIS-SU–88, pp. 14-23) **Thermodynamic of helium bubbles, pressure, density and equation of state for helium in bubbles.** Tebus, V.N. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Neorganicheskikh Materialov, Moscow (USSR)). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *Physics of radiation damages and radiation science of materials. Scientific-technical collection.* Order Number DE89012190/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 4(42).

The theoretical studies of thermodynamics of helium bubble formation are reviewed. The effect of gas(helium) nonideal nature on the type of thermodynamic functions is considered. It is shown that to describe the thermodynamics of small bubble formation (1-2nm) the account of helium atom interaction on the bubble surface and the relaxation process is necessary. Helium state in bubbles can be described by recently developed equations of real gas state. It is described that thermodynamic states and state equations can be used to obtain practically important correlations between bubble dimensions and other helium parameters (pressure, density and temperature) in it. The experimental data on helium density and pressure in bubbles obtained by recently developed spectroscopic methods and the method of small-angle X-ray studies are considered. It is shown that the experimental data prove theoretical conclusions that helium can be present in bubbles in the liquid or solid state at the pressure up to 10...100 GPa, when bubble growth takes place athermally and depends strength only. 26 refs.; 6 figs.; 1 tab.

38764 (INIS-SU–88, pp. 24-34) **Influence of carbon on the development of helium porosity in the Ni-C alloys irradiated by α-particles.** Kalin, B.A. (Moskovskij Inzhenerno-Fizicheskij Inst., Moscow (USSR)); Chernov, I.I.; Reutov, I.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *Physics of radiation damages and radiation science of materials. Scientific-technical collection.* Order Number DE89012190/JAW. Available from NTIS (US Sales Only), PC A02/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 4(42).

The method of translucenceelectron microscopy and profilometry are used to study the effect of low carbon additions (from 0.001 to 0.1 mass%) on the development of helium porosity in nickel. It is found that after irradiation by α-particles with the energy of 29 MeV and isothermal annealings at 1170 and 1270 K for 2 hours gas porosity develops in alloys whose parameters depend on carbon concentration. The maximum swelling is observed in the Ni+0.01% C alloy. At this carbon concentration under the given experimental conditions the segregation of highly disperse phase precipitates on the surface of pores takes place, that is why the increase of carbon content from 0.01 to 0.1% results in swelling decrease. 31 refs.; 7 figs.; 3 tabs.

38765 (INIS-SU–88, pp. 46-49) **Study on the gas-filled pores in metals on the electron loss spectra and optical spectra.** Golinej, Yu.I. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij); Kryuchenko, Yu.V.; Sugakov, V.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *Physics of radiation damages and radiation science of materials. Scientific-technical collection.* Order Number DE89012190/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 4(42).

The spectra of electron losses and optical spectra of metals with pores filled with inert gas crystallites are theoretically studied. The phenomenon of mixing of states of localized plasmons and exciton excitations in a crystalline is studied, as well as the phenomenon of dimensional quantization of electron excitations. 10 refs.; 2 figs.

38766 (JAERI-M–88-270) **Development of Ni-Cr-W superalloys for high temperature components in high temperature gas-cooled-reactors. Interim report.** Japan Atomic Energy Research Inst., Tokyo (Japan). Jan 1989. 74p. (In Japanese). Order Number DE89790898/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The development of new superalloys for applications to the high temperature components in high temperature gas-cooled reactors with coolant outlet temperature of around 1000degC is in progress. The program aims to develop new superalloys which are well balanced in high temperature strength, corrosion resistance, fabricability, weldability, etc. 19751 interim report is to summarize the results of the qualification tests performed by the Ad Hoc Committee on Advanced Superalloys until FY 1986 for the evaluation of the 1st, 2nd and 3rd experimental alloys. The main results obtained are as follows; (2) the addition of 10~70 ppm Y in combination with 35~55 ppm B had an advantage, (3) the additions of Fe and Nb, and the increasing of C content more than 0.03% had no advantage and (4) on the effects of the additions of Mn, Si and Ti, the further examinations are required.

38767 (LA-UR–89-2105) **Issues and future directions in subsecond thermophysics.** Shaner, J.W. Los Alamos National Lab., NM (USA). 1989. 5p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-8906164–1: 10. symposium on thermophysical properties, Gaithersburg, MD, USA, 20-23 Jun 1989). Order Number DE89014228/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The primary motivations for trying to measure thermophysical properties of materials on subsecond timescales are to extend measurements to higher temperatures than can be conveniently maintained continuously, or to make measurements on systems out of thermodynamic equilibrium. Since these measurements are difficult, one must keep in mind the needs for the data. These include the ability to use materials cleverly in new high-pressure/high- temperature applications, as well as the development of calibrated models for the response of materials to rapid energy deposition, by laser pulses, for example. Several key areas have been identified in which effort is needed for substantial progress in subsecond measurements, and which have unusual promise for useful new scientific results. These areas include the problems of high-temperature standards, equilibration during rapid heating, measurements at higher temperatures combined with higher pressures, measurements on specific interesting materials, and measurement of microstructural properties at high temperature and their relation to macroscopic response. Each of these areas will be touched upon here.

38768 (LA-UR–89-2150) **Thermophysical properties of liquid niobium.** Hixson, R.S.; Winkler, M.A. Los Alamos National Lab., NM (USA). 1989. 9p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890798–1-Vugraphs: AIRAPT and EHPRG international high pressure science and technology

conference, Paderborn, Germany, F.R., 17-21 Jul 1989). Order Number DE89014288/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Thermophysical properties of most liquid metals are difficult to measure because of the very high temperatures and pressures required, but they are important for several reasons. These include understanding the fundamental physics of liquid metals and experimental modeling and design of exploding wires, foils and fuses. The melting points of all but a few metals are at high temperatures, with many exceeding 2000 K. The critical points of most metals exceed temperatures and pressures that may be easily achieved in static high-pressure systems. Because of the limitations on temperatures that may be reached in static high-pressure experiments, various dynamic techniques have been developed to study liquid metals. We use a resistive pule heating method in which a cylindrical wire-shaped sample is made to expand along a isobaric path. During an experiment the sample is heated, made to melt, and enthalpy, temperature, and specific volume are measured. After the liquid end state is reached, a single sound speed measurement per experiment is made. From these fundamental properties, other properties such as thermal expansion coefficient bulk modulii, and compressibilities may be calculated. Here we report measurements that we have recently made on liquid niobium. 7 refs., 5 figs., 1 tab.

38769 (LBL–27187) **Fundamental studies of grain boundary structure and properties in ICB aluminum.** Westmacott, K.H.; Dahmen, U. Lawrence Berkeley Lab., CA (USA). May 1989. 18p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-8906157–2: 12. symposium on ion sources and ion-assisted technology, Tokyo, Japan, 5-7 Jun 1989). Order Number DE89014884/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Thin films prepared by the Ionized-Cluster-Beam (ICB) technique, pioneered at Kyoto University, are of great interest for both their fundamental structure and properties and their potential for practical applications. At Berkeley a research program has been initiated, in collaboration with professor Yamada and his colleagues at Kyoto University, to investigate a different aspect of ICB films. We are exploiting the unique bicrystal microstructure that forms with some thin film/substrate combinations to conduct a fundamental investigation of grain boundary structure and properties. Initially, the studies are being carried out on aluminum bicrystal films formed by deposition on a {100} silicon single crystal substrate. Two types of transmission electron microscopy (TEM) experiments will be reported. High resolution imaging of specific grain boundary segments is performed on a second HVEM capable of resolving the position of atom columns in the core regions of a grain boundary. Complementary information obtained by the two techniques is helping us to understand the structure and properties of grain boundaries as well as learn more about ICB thin films. In the final section of this paper, the results of preliminary high-resolution observations of silver clusters dispersed on a carbon grid are given. 10 refs., 8 figs.

38770 (MLM–3600) **Technology update – 89.** Fitzharris, P.A. (ed.). EG and G Mound Applied Technologies, Miamisburg, OH (USA). Jul 1989. 37p. Sponsored by DOE Defense Programs. DOE Contract AC04-88DP43495. Order Number DE89014407/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An overview of the following research areas from Mound technologies is presented: advanced joining processes, modeling continuous flow production, electrochemical corrosion testing, extending the temperature scale, laser diagnostics, and new alloys for glass-to-metal seals. 25 refs., 35 figs., 7 tabs.

38771 (PNL-SA–16378) **Freeze-dried tungsten heavy alloys.** White, G.D.; Gurwell, W.E. Pacific Northwest Lab., Richland, WA (USA). Mar 1989. 19p. Sponsored by DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-8906119–2: Powder metallurgy conference, San Diego, CA, USA, 11-14 Jun 1989). Order Number DE89014933/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Tungsten heavy alloy powders were produced from freeze-dried aqueous solutions of ammonium metatungstate and, primarily, sulfates of Ni and Fe. The freeze-dried salts were calcined and hydrogen reduced to form very fine, homogenous, low-density, W heavy alloy powders having a coral-like structure with elements of approximately 0.1 μm in diameter. The powders yield high green strength and sinterability. Tungsten heavy alloy powders of 70%, 90%, and 97% W were prepared by freeze drying, compacted, and solid-state (SS) sintered to full density at temperatures as low as 1200°C and also at conventional liquid-phase (LP) sintering temperatures. Solid-state sintered microstructures contained polygonal W grains with high contiguity; the matrix did not coat and separate the W grains to form low-contiguity, high-ductility structures. Liquid-phase sintered microstructures were very conventional in appearance, having W spheroids of low contiguity. All of these materials were found to be brittle. High levels of residual S accompanied by segregation of the S to all the microstructural interfaces are principally responsible for the brittleness; problems with S could be eliminated by using Fe and Ni nitrates rather than the sulfates. Unusually high hardness, approaching 48 HRC, was obtained from sintering at 1130°C. As-sintered hardness decreases as grain size increases with sintering temperature during SS sintering and with time during LP sintering. 8 refs., 9 figs., 2 tabs.

38772 (SAND–88-1163C) **Diffusion models of fatigue crack growth with sequence effects due to stationary random loading.** Veers, P.S.; Winterstein, S.R. Sandia National Labs., Albuquerque, NM (USA). 1989. 8p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890835–2: 5. international conference on structural safety and reliability, San Francisco, CA, USA, 8-11 Aug 1989). Order Number DE89008715/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A new fatigue crack growth model that includes load sequence effects is formulated. This model includes a load history dependent parameter, the reset stress, which reflects the state of residual compression at the crack tip. Unlike various models aimed at constant or block loads, this model includes constantly evolving crack closure effects under random amplitude loads. It is found to accurately predict crack growth of ASTM aluminum and SAE steel specimens. Simulation studies demonstrate the pronounced bias that may arise if these sequence effects are neglected. Simple analytical corrections for this bias are established, and show excellent agreement with simulation. These use a hierarchy of diffusion models on different time scales; e.g., steady-state reset stress models at various crack sizes. Higher-order statistics can also be found from numerical solution of the vector diffusion equations. 17 refs., 6 figs.

38773 (SAND–89-0324C) **Effective masses and g factors for 2-D light holes in InSb.** Schirber, J.E.; Tigges, C.P.; Dawson, L.R.; Hjalmarson, H.P.; Fritz, I.J. Sandia National Labs., Albuquerque, NM (USA). 1989. 7p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890621–1: International conference on narrow-gap semiconductors and related materials, Gaithersburg, MD, USA, 12-15 Jun 1989). Order Number DE89014899/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The light holes in InSb are characterized using a Shubnikov-de Haas technique by exploiting the Type II band offset of an $InAs_{.15}Sb_{.85}$/InSb strained layer superlattice. The data are analyzed to determine the effective masses and g factors as a function of carrier concentration. 10 refs., 2 figs., 1 tab.

38774 (SAND–89-0978C) **Dynamic quasi-isentropic loading of tungsten.** Chhabildas, L.C.; Asay, J.R.; Barker, L.M. Sandia National Labs., Albuquerque, NM (USA). 1989. 3p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890798–2: AIRAPT and EHPRG international high pressure science and technology conference, Paderborn, Germany, F.R., 17-21 Jul 1989). Order Number DE89013924/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Experiments have been performed on smooth bore guns to obtain quasi-isentropic compression in tungsten to stresses approaching 250 GPa. Quasi-isentropic loading was introduced in the material either by using graded density or layered impactors. Results of these experiments indicate that the quasi-isentrope lies above the Hugoniot up to ~14 GPa, contrary to initial expectations. These results suggest that the dynamic yield strength of the material is higher for the relatively slower rates of isentropic loading. 4 refs., 2 figs.

38775 (SAND–89-1003C) **Powder metallurgy in aerospace structural applications—Current use and future trends.** Froes, F.H.; Rowe, R.G.; Das, S.K.; Stephens, J.J. Sandia National Labs.,

Albuquerque, NM (USA). 9 Jun 1989. 22p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8906119–3: Powder metallurgy conference, San Diego, CA, USA, 11-14 Jun 1989). Order Number DE89014940/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The major role played by materials in providing advances in systems performance as we move towards the twenty-first century is reviewed. Specific developments in the powder metallurgy/rapid solidification of alloys, based on aluminum, magnesium, titanium, niobium, and copper are discussed in detail. 47 refs., 12 figs.

38776 (SFB–256-60(prepr.)) **Mathematical aspects of bending of plates with transverse shear deformation.** Constanda, C. Bonn Univ. (Germany, F.R.). Sonderforschungsbereich 256 - Nichtlineare Partielle Differentialgleichungen. Dec 1988. 50p. Available from Copy held by UB/TIB Hannover.

The boundary integral equation method is applied to investigate the existence and uniqueness of regular solutions of a two-dimensional theory of bending of plates with transverse shear deformation. The stress function technique is then used to obtain the general analytic solution of the equilibrium equations and to elucidate the physical meaning of the mathematical restrictions arising in the analysis of the model. (orig.).

38777 Thermomechanical history effects on the sensitization of austenitic stainless steels. Bruemmer, S.M. (Battelle-Pacific Northwest Lab., Richland, WA (US)); Page, R.E.; Atteridge, D.G.; Schneider, R.P. v.v of Corrosion '85. National Assoc. of Corrosion Engineers, Houston, TX (1985). (CONF-850311–: National Association of Corrosion Engineers annual meeting and materials performance and corrosion show, Boston, MA, USA, 25-29 Mar 1985).

The effects of isothermal heat treatment, thermal cycling and simultaneous strain on the sensitization development in Type 304 and 316 stainless steels have been investigated. Degree of sensitization measurements have been performed on weld simulation and welded pipe specimens using the electrochemical potentiokinetic reactivation (EPR) test technique. Heat affected zone sensitization has been mapped and compared to measured temperatures and strains on a pass-by-bass basis.

38778 Radiation-induced alkali formation and its effect on the corrosion of grade-12 titanium in rock salt nuclear waste repositories. Ahn, T.M. (Brookhaven National Lab., Upton, NY (US)); Soo, P.; Panno, S.V. v.v of Corrosion '85. National Assoc. of Corrosion Engineers, Houston, TX (1985). (CONF-850311–: National Association of Corrosion Engineers annual meeting and materials performance and corrosion show, Boston, MA, USA, 25-29 Mar 1985).

Alkali solution was formed in high level nuclear waste repositories by gamma ray effects. The alkali effects of Grade-12 Titanium corrosion were presented for uniform corrosion, stress corrosion, crevice corrosion and hydrogen uptake.

38779 On the mechanics of failure in ceramic/metal bonded systems. Evans, A.G. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)); Ruhle, M. v.v of Electronic packaging materials science. Geiss, E.A.; Tu, K.N.; Uhlmann, D.R. Materials Research Society, Pittsburgh, PA (1985). (CONF-841157–: Materials Research Society annual meeting, Boston, MA, USA, 26-29 Nov 1984).

Stress concentrations that develop in metal/ceramic bonded systems have been evaluated and shown to encourage crack propagation at, or near, the edge of bonded interfaces. Experimental indentation observations on Nb/Al_2O_3 confirm the existence of the predicted stress concentrations. In this system, failure was invariably observed to initiate in the ceramic, such that quasi-static cracks located at the interface exhibited crack blunting. However, substantial dynamic reduction in the crack growth resistance of the interface are inferred from fracture surface observations. Implications for the optimal strengths of ceramic/metal bonded systems are presented.

38780 Universal binding energy relations in metallic adhesion. Ferrante, J. (NASA Lewis Research Center, Cleveland, OH (US)); Smith, J.R.; Rose, J.H. v.v of Electronic packaging materials science. Geiss, E.A.; Tu, K.N.; Uhlmann, D.R. Materials Research Society, Pittsburgh, PA (1985). (CONF-841157–: Materials Research Society annual meeting, Boston, MA, USA, 26-29 Nov 1984).

Scaling relations have been discovered which map the adhesive binding energy onto a single universal binding energy curve. These binding energies are calculated for all combinations of Al(111), Zn(0001), Mg(0001), and Na(110) in contact. The scaling involves normalizing the energy by the maximum binding energy and normalizing distances by a suitable combination of Thomas-Fermi screening lengths. The calculated cohesive energies of K, Ba, Cu, Mo, and Sm scale by similar simple relations, suggesting the universal relation may be more general than for the simple free-electron metals for which it was derived. In addition, the scaling length was defined more generally in order to relate it to measurable physical properties. Further this universality can be extended to chemisorption and molecular binding. The implications of this scaling have been explored and have produced some interesting results and verifications. A simple and yet quite accurate prediction of a zero temperature equation of state (volume as a function of pressure for metals and alloys) is presented. Thermal expansion coefficients and melting temperatures are predicted by simple, analytic expressions, and results compare favorably with experiment for a broad range of metals.

38781 Transfer-matrix analysis of a two-dimensional quasicrystal. Widom, M. (Department of Physics, Carnegie Mellon University, Pittsburgh, Pennsylvania 15213(US)); Deng, D. P.; Henley, C. L. *Physical Review Letters (USA)*, 63(3): 310-313 (17 Jul 1989).

We investigate the quasicrystalline state of a two-dimensional binary alloy in a discrete tiling approximation. Through transfer-matrix calculations we determine the configurational entropy over a range of concentrations. We find that the entropy density is maximized by a state with tenfold symmetry at the quasicrystal concentration. Derivatives of the entropy density at its maximum yield values for the phason elastic constants. Our results confirm the existence of quasi-long-range translational order in equilibrium quasicrystalline alloys and lend support to the random-tiling model of quasicrystals.

38782 Origin of the longitudinal-ultrasonic-attenuation peak in heavy-fermion superconductors. Coffey, L. (Department of Physics, Ohio State University, Columbus, Ohio 43210-1106(US)). *Physical Review [Section] B: Condensed Matter (USA)*, 40(1): 715-718 (1 Jul 1989).

Longitudinal-ultrasonic-attenuation $\alpha(T)$ in the stronglycorrelated heavy-fermion superconductors UBe_{13} andUPt_3 shows an unusual peak below the superconducting transitiontemperature T_c. This feature can arise from a purely normal-stateproperty, namely the large, heavy-electron effective massm_e^*. Thus, the peak may not necessarily be an indication ofanisotropic superconductivity.

38783 Muon-spin relaxation studies of weak magnetic correlations in $U_{1-x}Th_xBe_{13}$. Heffner, R. H. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545(US)); Willis, J. O.; Smith, J. L.; Birrer, P.; Baines, C.; Gygax, F. N.; Hitti, B.; Lippelt, E.; Ott, H. R.; Schenck, A.; and others. *Physical Review [Section] B: Condensed Matter (USA)*, 40(1): 806-809 (1 Jul 1989).

Zero-field positive muon-spin relaxation rates in$U_{0.965}Th_{0.035}Be_{13}$provide definitive evidence for the onset of magnetic correlations at the lowerphase transition at temperature T_{c2} below thenormal-superconducting transition at T_{c1}. The transition atT_{c2} is found to be second order and mean field like, with amoment $(10^{-3}–10^{-2})\mu_B$/f atom.Candidates for the second phase, such as magnetic order and magneticsuperconducting states, are discussed.

38784 Droplet model for autocorrelation functions in an Ising ferromagnet. Tang, C. (Institute for Theoretical Physics,University of California, Santa Barbara, California 93106 (US)); Nakanishi, H.; Langer, J. S. *Physical Review [Section] A: General Physics (USA)*, 40(2): 995-1003 (15 Jul 1989).

The autocorrelation function,$C(t)=\langle S_i(0)S_i(t)\rangle-\langle S_i^2\ (0)\rangle$, of Ising spins in an ordered phase ($T<T_c$) is studied via a droplet model. Only noninteracting spherical droplets are considered. The Langevin equation for droplet fluctuations is studied in detail. The relaxation-rate spectra for the corresponding Fokker-Planck equation are

found to be (1) continuous from zero for dimension d=2, (2) continuous with a finite gap for d=3, and (3) discrete for $d \geq 4$. These spectra are different from the gapless form assumed by Takano, Nakanishi, and Miyashita for the kinetic Ising model. The asymptotic form of $C(t)$ is found to be exponential for $d \geq 3$ and stretched exponential with the exponent β=1/2 for d=2. Our results for $C(t)$ are consistent with the scaling argument of Huse and Fisher, but not with Ogielski's Monte Carlo simulations.

38785 Cu(111) and Ag(111) surface-phonon spectrum: The importance of avoided crossings. Nelson, J. S. (Sandia National Laboratories, Livermore, California 94550-5800(US)); Daw, M. S.; Sowa, E. C. *Physical Review [Section] B: Condensed Matter (USA),* 40(3): 1465-1480 (15 Jul 1989).

Embedded-atom method (EAM) calculations of the phonon energies, polarizations, and first- and second-neighbor interatomic-force-constant tensors of the clean Cu(111) and Ag(111) surfaces are presented. Using embedded-atom parameters fit to bulk properties, we find that the EAM provides an accurate and detailed description of the lattice dynamics of these surfaces, in good agreement with the measured surface vibrational spectra. We find only modest 10–15 % changes in the surface force constants for both Cu and Ag from their bulk values. Our calculations also suggest an explanation for the anomalous softening of the longitudinal resonance mode along the ΓM symmetry line in terms of an avoided crossing of first- and second-layer sagittal-plane modes.

38786 First-principles calculations of equilibrium ground-state properties of Au and Ag. Takeuchi, N. (Ames LaboratoryU.S. Department of Energy and Department of Physics, Iowa State University, Ames, Iowa 50011(US)); Chan, C. T.; Ho, K. M. *Physical Review [Section] B: Condensed Matter (USA),* 40(3): 1565-1570 (15 Jul 1989). DOE Contract W-7405-ENG-82.

The equilibrium ground-state properties of the noble metals Ag and Au are calculated from first principles, using norm-conserving pseudopotentials. We have obtained the cohesive energies, bulk moduli, and lattice constants of Ag and Au, which are in very good agreement with experiments. We have also examined the importance of the relativistic effects in governing the structural properties of Au.

38787 Concentration profiling using x-ray reflectivity: Application to Cu-Al interfaces. Chen, H. (Brookhaven National Laboratory, Upton, New York 11973(US)); Heald, S. M. *Journal of Applied Physics (USA),* 66(4): 1793-1799 (15 Aug 1989).

Synchrotron radiation measurements were made using glancing-angle x-ray reflectivity to study Cu-Al thin-film interfaces. The reflectivity data contains information about film morphology, and its sensitivity to the concentration of an element can be improved by measuring above and below an absorption edge. An analysis routine for the reflectivity data was developed to extract a model of the concentration profile and roughness. The results are compared from Cu-Al interfaces prepared in an ultrahigh vacuum environment, with and without exposure to oxygen before Al deposition. The reactions caused by thermal annealing at temperatures ranging from 65 to 160 °C are also studied. Density profiles of the two samples after various anneals indicate that there are different levels of mixing at the interface, and the tendency to reach a similar level after high-temperature (140–160 °C) anneals. The low levels of reaction observed in this work are difficult to detect by other techniques, such as Rutherford backscattering spectroscopy. In view of the simplicity and the sensitivity of the glancing-angle x-ray reflectivity technique, it can be generalized to other thin-film systems.

38788 Multiple deuterium occupancy of vacancies in Pd and related metals. Nordlander, P. (Department of Physics and Astronomy, Rutgers University, Piscataway, New Jersey 08855-0849(US)); Norskov, J. K.; Besenbacher, F.; Myers, S. M. *Physical Review [Section] B: Condensed Matter (USA),* 40(3): 1990-1992 (15 Jul 1989).

The binding energies of up to six deuterium atoms into monovacancies of Pd, Ni, Fe, Cu, Nb, and Mo have been calculated using the effective-medium theory. For all metals it is found that at least six D atoms can be accommodated in the vacancy. Of the systems studied the deuterium-deuterium interaction is found to be least repulsive for Pd. This multiple occupancy of the vacancy defect can have potentially significant implications for the recently proposed fusion of D atoms in Pd.

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Refer also to citation(s) 38758, 38767, 38770, 38779, 38842, 38954, 38959, 38960, 38961, 38962, 38963

38789 (AERE-R–13396) **Insertion compounds of uranium oxides. A review.** Ball, R.G.J. UKAEA Harwell Lab. (UK). Chemistry Div. Feb 1989. 27p. Order Number DE89631031/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Insertion compounds are formed by the intercalation of an electropositive species, such as hydrogen or an alkali metal, with minimal structural rearrangement of the host oxide. In this report a review of the measured structural, thermodynamic and transport properties of the insertion compounds of α-U_3O_8, α-UO_3, γ-UO_3, δ-UO_3 and related systems is given.

38790 (BNL–42865) **Structural studies of $La_{2-x}Ba_xCuO_4$ between 11-293 K.** Cox, D.E.; Zolliker, P.; Axe, J.D.; Moudden, A.H.; Moodenbaugh, A.R.; Xu, Y. Brookhaven National Lab., Upton, NY (USA). 1988. 11p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH00016. Order Number DE89015104/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

Neutron powder diffraction data have been collected from samples of $La_{1.9}Ba_{0.1}CuO_4$ and $La_{1.85}Ba_{0.1515}CuO_4$ in the temperature range 11-293K. The first material undergoes a phase transition from the tetragonal K_2NiF_4-type structure (space group I4/mmm) to the orthorhombic La_2CuO_4-type structure (space group Bmab) at about 280K, and then a second transition to another type of tetragonal (or near-tetragonal) structure with probable space group $P4_2/ncm$. The latter transition occurs predominantly between 50-40K, but about 10% of the orthorhombic phase persists down to 15K. Rietveld refinement was carried out at selected temperatures in the different structural regions. The differences among the low temperature structures can be characterized by tilting of the CuO_6 octahedra about different rotation axes on the basis of the simple X-Y model previously proposed by Axe and coworkers. The tilt angle, which is a measure of the long-range order parameter, is about 3.5° at 15K. Data sets were also collected from $La_{1.85}Ba_{0.15}CuO_4$ at 293, 90 and 11K. At the two latter temperatures there was some peak broadening consistent with the distortions observed in previous high resolution neutron [Paul and co-workers] and x-ray [Axe and co-workers] powder studies. Rietveld analysis of the data indicated the presence of local octahedral displacements, but it was not possible to determine the nature of the correlations. 20 refs., 5 figs., 3 tabs.

38791 (CONF-890718–8) **Magnetic hysteresis and ac response of $YBa_2Cu_3O_x$.** Kerchner, H.R.; Feenstra, R.; Thomson, J.O.; Thompson, J.R.; Kim, Y.C.; Christen, D.K.; Sekula, S.T. Oak Ridge National Lab., TN (USA). Jul 1989. 3p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From International conference on materials and mechanisms of superconductivity - high-temperature superconductors; Stanford, CA, USA; 23-28 Jul 1989. Order Number DE89015043/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The dc magnetic hysteresis and audio-frequency ac susceptibility were studied for $YBa_2Cu_3O_x$ films of different epitaxial orientations on $SiTiO_3$. The apparent critical current density deduced from the ac susceptibility is in reasonable agreement with that deduced from the slowly-swept-field dc result, but not with the quasistatic dc hysteresis. Both the ac-voltage waveform from the mutual inductance bridge and the slow decay of magnetic moment in a static applied field show magnetic flux creep. 3 refs., 3 figs.

38792 (CONF-8904238–1) **Metallic bonding to high-temperature superconducting ceramics.** Hague, D.C. Argonne National Lab., IL (USA). 1989. 5p. Sponsored by DOE Energy Research. DOE Contract W-31109-ENG-38. From 3. national conference on undergraduate research; San Antonio, TX, USA; 27-29 Apr 1989. Order Number DE89014668/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Yttrium-barium-copper-oxide (123) superconducting ceramic pellets where obtained from J.P. Singh and K.C. Goretta at Argonne National Laboratory (ANL). The pellets were prepared in

accordance with established methods. The pellets were then thermocompressively bonded by the methods of Meiser, et al. The resistivities of the samples were determined using a Keithley 181 Nanovoltmeter and a Keithley 227 Current Source. The resistances were taken over a range of 0.1 amp to 1 amp and were converted to interfacial resistivities. A simple tensile test was also applied to the samples to determine bond strengths. 7 refs., 1 fig.

38793 (CONF-8906135–2) **Microwave sintering of ceramics.** Snyder, W.B. Oak Ridge National Lab., TN (USA). 1989. 5p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. From International congress on technology and technology exchange; New York, NY, USA; 28 Jun 1989. Order Number DE89014769/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Successful adaptation of microwave heating to the densification of ceramic materials require a marriage of microwave and materials technologies. Using an interdisciplinary team of microwave and materials engineers, we have successfully demonstrated the ability to density ceramic materials over a wide range of temperatures. Microstructural evolution during microwave sintering has been found to be significantly different from that observed in conventional sintering. Our results and those of others indicate that microwave sintering has the potential to fabricate components to near net shape with mechanical properties equivalent to hot pressed or hot isostatically pressed material. 6 refs., 11 figs.

38794 (IGCAR–96) **Thermal expansion and phase transformation studies on some materials by high temperature x-ray powder diffractometry.** Rajagopalan, S.; Kutty, K.V.G.; Jajoo, H.K.; Ananthakrishnan, S.K.; Asurvatharaman, R. Indira Gandhi Centre for Atomic Research, Kalpakkam (India). 1988. 27p. Order Number DE89631032/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A high temperature chamber based on electrical resistance heating has been integrated to an existing x-ray powder diffractometer. The system is capable of going upto 2500degC at programmed rates of heating. Temperature measurement is carried out by means by Pt/Rh or W/Re thermocouples or by optical pyrometry depending upon the temperature range. Provision exists for performing high temperature x-ray diffractometry in vacuum or in a gaseous atmosphere of low x-ray absorption. The x-ray optical alignment has been ensured by accurately measuring the unit cell lengths of x-ray diffraction standards like silicon and tungsten. The thermocouples have been calibrated within the system by monitoring the melting points of gold and silver. The well characterized transformation of zirconia from the monoclinic to tetragonal structure occuring around 1100degC has been satisfactorily reproduced . The high temperature phase transitions in some rare earth oxides have been studi ed. lattice parameter measurements on a variety of materials as a function of temperature upto 1500degC have been carried out and the data found to be in agreement with the literature values. From the measured lattice parameter values, percentage thermal expansion and coefficients of thermal expansion have been calculated for many substances from room temperature to 15000degC. (author). 20 refs., 9 figs.

38795 (INIS-mf–11440, pp. 362-363) **Vibration spectrum of hydrogen in zirconium hydrides with uranium.** Padureanu, I.S. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering); Rapeanu, S.N.; Ion, M.; Rotarescu, G.; Bascoveanu, I.; Kozlov, J.A.; Natkaniec, I.; Semenov, V.A. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics*. Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Inelastic neutron scattering measurements have been performed on ZrHsub(1.84)Usub(0.32) and ZrHsub(1.6)Usub(0.32) by means of the TOF spectrometers DIN-2PI and KDSOG-M at IBR-2 reactor, JINR-Dubna. (authors).

38796 (LA–11613-MS) **High-temperature superconductor materials processing: Development of environmentally acceptable processing technologies.** Peterson, E.J.; Wangen, L.E.; Ott, K.C.; Hargis, K.M.; Hakonsen, T.E.; Whaley, T.W.; Parkinson, W.J. Los Alamos National Lab., NM (USA). Jul 1989. 14p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-36. Order Number DE89014391/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Los Alamos National Laboratory, as a national scientific resource, should be a major participant in the development of new technologies and the improvement of existing technologies that will enhance the nation's industrial competitiveness. Because the Laboratory is a national resource we also must take the broadest view of technology development and technology transfer. As we endeavor to convert our basic research into useable technologies that can be transferred to the industrial sector, we must recognize that the job remains incomplete when the product engineering phase is accomplished. A technology or product application that industry cannot implement because of health and environmental constraints will not contribute to our industrial competitiveness. Similarly, a sophisticated technology not accompanied by the appropriate expert knowledge base and process control strategies when technology transfer is attempted will be of marginal use to industry. Thus, it is essential for the Laboratory to take a multidimensional approach to technology development and technology transfer to the industrial sector. The superconducting ceramic oxide materials processing effort of the Exploratory Research and Development Center at Los Alamos provides an excellent opportunity to develop strategies that will address these issues. 2 figs.

38797 (LA-UR–89-2168) **Laboratory investigations: Low earth orbit environment chemistry with spacecraft surfaces.** Cross, J.B. Los Alamos National Lab., NM (USA). 1989. 8p. Sponsored by National Aeronautics & Space Administration. DOE Contract W-7405-ENG-36. (CONF-890799–1: Space operations automation and robotics workshop, Houston, TX, USA, 25-27 Jul 1989). Order Number DE89014280/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Long-term space operations that require exposure of material to the low earth orbit (LEO) environment must take into account the effects of this highly oxidative atmosphere on material properties and the possible contamination of the spacecraft surroundings. Ground-based laboratory experiments at Los Alamos using a newly developed hyperthermal atomic oxygen (AO) source have shown that not only are hydrocarbon based materials effected but that inorganic materials such as MoS_2 are also oxidized and that thin (750A) protective coatings such as Al_2O_3 can be breached, producing oxidation of the underlying substrate material. Gas-phase reaction products, such as SO_2 from oxidation of MoS_2 and CO and CO_2 from hydrocarbon materials, have been detected and have consequences in terms of spacecraft contamination. Energy loss through gas-surface collisions causing spacecraft drag has been measured for a few select surfaces and has been found to be highly dependent on the surface reactivity. 10 refs., 11 figs.

38798 (LBL–27267) **States of oxygen ordering in $YBa_2Cu_3O_z$.** de Fontaine, D. Lawrence Berkeley Lab., CA (USA). May 1989. 15p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890480–1: Conference on oxygen disorder effects in high T_c superconductors, Trieste, Italy, 18-21 Apr 1989). Order Number DE89014893/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The compound $YBa_2Cu_3O_z$ (1-2-3) was the first one whose superconducting transition temperature exceeded the technologically important temperature of 77K. Actually, the 1-2-3 compound at close to oxygen stoichiometry $z = 7$ became superconducting at about $T_c = 90K$, with T_c dropping by increments as z decreased from the value 7. In the 90K superconducting phase, occupied sites form O–Cu–O chains, and the resulting three-dimensional structure has orthorhombic symmetry. When available sites in the mirror plane are occupied statistically by O ions, the resulting structure has tetragonal symmetry and the material is nonsuperconducting. It thus appears that the tetragonal to orthorhombic transition in the 1-2-3 compound can be modeled by an order-disorder transition in the mirror plane. It is the object of this paper to review the properties of this transition and to derive appropriate phase diagrams pertaining to oxygen ordering in the plane. Much pertinent information concerning oxygen ordering in 1-2-3 is reviewed in a recent paper by Beyers and Shaw. 37 refs., 8 figs.

38799 Preparation of superconducting Bi-Sr-Ca-Cu-O fibers. LeBeau, S. E. (Babcock and Wilcox Research Center, Alliance, Ohio 44601-2196 (US)); Righi, J.; Ostenson, J. E.; Sanders, S. C.; Finnemore, D. K. *Applied Physics Letters (USA),* 55(3): 292-294 (17 Jul 1989). DOE Contract W-7405-ENG-82.

Procedures have been developed for the preparation of long slender fibers of Bi-Sr-Ca-Cu-O using a gas jet to shape and freeze the material. The fibers emerge in amorphous form and are converted to the $Bi_2Sr_2Ca_1Cu_2O_x$ phase by subsequent heat treatment. Magnetization and scanning electron microscopy studies show the material to be a very fine grained bulk superconductor with intragranular critical currents of 7×10^6 A/cm^2 at 5 K and 1.8 T.

38800 Evidence for local composition variations within $YBa_2Cu_3O_{7-\delta}$ grain boundaries. Babcock, S. E. (Applied Superconductivity Center & Department of Materials Science and Engineering, University of Wisconsin, Madison, Wisconsin 53706 (US)); Larbalestier, D. C. *Applied Physics Letters (USA),* 55(4): 393-395 (24 Jul 1989).

The composition variations associated with grain boundaries in bulk sintered $YBa_2Cu_3O_{7-\delta}$ have been investigated by means of energy-dispersive x-ray microanalysis in a high spatial resolution scanning transmission electron microscope. A series of composition profiles indicates that considerable variations in composition occur on a very local scale both parallel and perpendicular to these grain boundaries. The regular, oscillatory (period ~25 nm) nature of the composition variations observed along a grain boundary suggests that these heterogeneities may be an intrinsic feature of the boundary. Some possible implications of these observations for percolative conduction mechanisms are discussed briefly.

38801 Response to "Comment on 'Aluminum cladding of high T_c superconductor by thermocompression bonding' ". Richardson, T. J. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720 (US)); De Jonghe, L. C. *Applied Physics Letters (USA),* 55(3): 321-322 (17 Jul 1989).

We are not convinced that the objections raised by Harman require basic me tallurgical changes , nor that further development is a waste of time and expen se. It is our belief that these grapes ought first to be tasted before they be declared sour. (AIP)

38802 $YBa_2Cu_3O_{7-\delta}$ films deposited by a novel ion beam sputtering technique. Kingon, A. I. (Department of Materials Science and Engineering, North Carolina State University, Raleigh, North Carolina 27695-7907 (US)); Auciello, O.; Ameen, M. S.; Rou, S. H.; Krauss, A. R. *Applied Physics Letters (USA),* 55(3): 301-303 (17 Jul 1989). DOE Contract W-31-109-ENG-38.

Superconducting films of $YBa_2Cu_3O_{7-\delta}$ have been synthesized in a novel ion beam sputter deposition system which features a rotating target holder with BaO_2, CuO, and Y_2O_3 as the sputtering targets. The dwell time of the ion beam on each oxide target is determined by a computer-controlled feedback loop using the signal from a programmable quartz crystal resonator. The sputtered fluxes of all film components originate from the same spatial location, ensuring homogeneous film composition. The results presented demonstrate for the first time an automated ion beam sputter deposition system with the capability of producing high T_c superconducting films by controlled sputtering of either elemental metallic components or oxide precursors. The concept may be extended to include processes such as patterning, production of layered structures (junctions), and film encapsulation necessary for microcircuit manufacturing based on high T_c superconducting films.

38803 Radio frequency surface resistance of large-area Bi-Sr-Ca-Cu-O thick films on Ag plates. Bohn, C. L. (Engineering Physics Division, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, Illinois 60439 (US)); Delayen, J. R.; Balachandran, U.; Lanagan, M. T. *Applied Physics Letters (USA),* 55(3): 304-306 (17 Jul 1989). DOE Contract W-31-109-ENG-38.

Films nominally 80 μm thick of Bi-Sr-Ca-Cu-O on silver substrates with surface areas from 1.25 to 182 cm^2 were fabricated using two different processing procedures. Their rf surface resistances were measured as functions of temperature in the frequency range 2.65–29.2 GHz at low rf field amplitudes using cylindrical resonant cavities. The critical temperatures of the films were in the range 81–83 K. At *X*-band frequencies, the surface resistances matched that of room-temperature copper. The results were comparable to recent data on small pellets of bulk Bi-Sr-Ca-Cu-O.

38804 Effects of junction resistance and counterelectrode material on point-contact tunneling into single- and polycrystalline $YBa_2Cu_3O_{7-y}$. Moog, E.R. (Argonne National Lab., IL (USA)); Hawley, M.E.; Gray, K.E.; Liu, J.Z.; Hinks, D.G.; Capone, D.W. II; Downey, J. *Journal of Low Temperature Physics (USA),* 71(5-6): 393-402 (Jun 1988). DOE Contract W-31-109-ENG-38.

The effects of junction resistance and counterelectrode material on the results of point-contact tunneling studies into single- and polycrystalline $YBa_2Cu_3O_{7-y}$ are illustrated. Although reasonably symmetric I(V) curves predominantly indicate energy gap values $\Delta \approx 20$ meV, large asymmetries are often found for high-resistance junctions. Very low-resistance junctions show the expected behavior of pure metallic bridge and indicate $\Delta \approx 25$-30 meV.

38805 Photothermal measurements of high T_c superconductors. Fanton, J. T. (Edward L. Ginzton Laboratory, W. W. Hansen Laboratories, Stanford University, Stanford, California 94305-4085(US)); Mitzi, D. B.; Kapitulnik, A.; Khuri-Yakub, B. T.; Kino, G. S.; Gazit, D.; Feigelson, R. S. *Applied Physics Letters (USA),* 55(6): 598-599 (7 Aug 1989).

We demonstrate a photothermal method for making point measurements of the thermal conductivities of high T_c superconductors. Images made at room temperature on polycrystalline materials show the thermal inhomogeneities. Measurements on single-crystal $Bi_2Sr_2CaCu_2O_x$ compounds reveal a very large anisotropy of about 7:1 in the thermal conductivity.

38806 Oxygen ion irradiation of $Tl_2Ca_2Ba_2Cu_3O_{10}$ superconductors. Barbour, J. C. (Sandia National Laboratories, Albuquerque, New Mexico 87185(US)); Kwak, J. F.; Ginley, D. S.; Peercy, P. S. *Applied Physics Letters (USA),* 55(5): 507-509 (31 Jul 1989). DOE Contract AC04-76DP00789.

The superconducting transport properties of polycrystalline $Tl_2Ca_2Ba_2Cu_3O_{10}$ thin films irradiated with 740 keV oxygen ions were monitored as a function of fluence. Both the transition temperature (T_c) and the critical current density (J_c) decreased rapidly with fluence; however, the transition temperature onset remained constant. A fluence of 2×10^{14} O/cm^2 (0.028 dpa) was sufficient to eliminate superconductivity in the films. J_c at 76 K decreased from 25 000 A/cm^2 in the unirradiated sample to 2000 A/cm^2 after a fluence of 2.1×10^{13} O/cm^2. A room-temperature anneal caused both T_c and the normal-state resistivity to recover slightly after low-fluence irradiations.

38807 Crystallization kinetics for quenched Bi-Ca-Sr-Cu-O glasses. Tatsumisago, M. (Department of Chemistry, Purdue University, West Lafayette, Indiana 47907(US)); Angell, C. A.; Akamatsu, Y.; Tsuboi, S.; Tohge, N.; Minami, T. *Applied Physics Letters (USA),* 55(6): 600-602 (7 Aug 1989).

The kinetics of crystallization in the $Bi_xCaSrCu_2O_w$ (x=1.5, 2.7) glasses prepared by twin-roller and metal-plate quenching methods have been studied by a nonisothermal method using differential scanning calorimetry. Scanning electron microscopy studies suggest surface crystallization as the dominant mechanism. The activation energy for crystal growth calculated from modified Kissinger plots assuming surface nucleation decreased with an increase in the Bi content. Such a composition dependence is consistent with that of the activation energy for viscous flow in the glass transformation range.

38808 Low-temperature thermal conductivity of single-crystal $Bi_2Sr_2CaCu_2O_8$. Zhu, D. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, 1110 West Green Street, Urbana, Illinois 61801(US)); Anderson, A. C.; Bukowski, E. D.; Ginsberg, D. M. *Physical Review [Section] B: Condensed Matter (USA),* 40(1): 841-843 (1 Jul 1989). DOE Contract AC02-76ER01198.

The thermal conductivity κ of a single crystal of superconducting$Bi_2Sr_2CaCu_2O_8$ has beenmeasured at temperatures from 0.03 to 9 K. Below 2 K, where κ displaysa T^2 dependence, the results agree in both temperature dependenceand magnitude with that of single-crystal superconducting$YBa_2Cu_3O_{7-x}$

or$HoBa_2Cu_3O_{7-x}$, and are remarkablysimilar to the thermal conductivity of glasses.

3606 Other Materials

Refer also to citation(s) 38097, 38193, 38398, 38440, 38751, 38767, 38797, 38969, 38970, 38973, 38975

38809 (AD-A–204979/9/XAB) **Composite materials testing for remotely piloted vehicles. Memorandum report.** Quraishi, N. Naval Research Lab., Washington, DC (USA). 25 Jan 1989. 47p. (NRL-MR–6196). Available from NTIS, PC A03/MF A01.

The purpose of this report is to test and evaluate the material properties of composites, built by Code 5712 of the Naval Research Laboratory, for use on Remotely Piloted Vehicles (RPV's). These composite materials are generally combinations of Balsa wood and Kevlar or Fiberglas, using Epoxy as a binder. The specific requirement of these composites necessitate that the weight of the material be kept at a minimum. In accordance with this requirement, a fabrication procedures was adopted that deviates from that traditionally established in the composites field. The main difference is that, in the construction of these composites no dam is used to surround the material while the epoxy cures. Conventional composite fabrication procedures use a dam to prevent epoxy (resin) from migrating away from the material. This fabrication process was examined in relation to it's effects on the material properties of these composites.

38810 (BMU–1988-183) **Investigation of sealing materials and tight enclosure systems with regard to transport and disposal of radioactive waste. Interim report 1986.** Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten. Fessel, J.; Kowalewsky, H.; Weise, H.P.; Wenz, R.; Wolk, T. Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.). Jun 1987. 39p. (In German). Contract BMU St.Sch. 00943. Available from GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.).

An essential task of the research project is the investigation of the sealing effect of elastomers under different limiting conditions, which are important for the physical practice. A matter of special interest is the measurement of gas permeation through sealing materials within the range of the admissible operating temperatures of 250 K<T>500 K and the influence of radioactive radiation on the usefulness of the sealing material. Furthermore, the additionally occurring leakages - especially for temperatures of T<250 K and T>500 K - should be examined and the leakage rates should be determined. The selected measuring method is based on the pressure increase method as well as on the exact measurement of the limiting system pressure. (orig./RB).

38811 (CONF-8906157–1) **Ion beam deposition of epitaxial germanium and gallium arsenide layers.** Haynes, T.E.; Zuhr, R.A.; Pennycook, S.J.; Larson, B.C. Oak Ridge National Lab., TN (USA). May 1989. 11p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From 12. symposium on ion sources and ion-assisted technology; Tokyo, Japan; 5-7 Jun 1989. Order Number DE89014044/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Low-energy, mass-separated ion beams of Ge, Ga, and As at 30 and 40 eV have been used to deposit isotopically pure, epitaxial layers of ^{76}Ge and ^{70}Ge on GaAs(100) and of $^{69}GaAs$ and $^{71}GaAs$ on Ge(100). Epitaxial growth of Ge and GaAs layers was achieved at temperatures as low as 250°C. Growth of the compound GaAs was accomplished by repetitive magnetic switching between the Ga^+ and As^+ ion beams obtained simultaneously from a single ion source. The structure of the deposited layers is characterized by ion channeling, transmission electron microscopy, and x-ray diffraction. 21 refs., 12 figs., 2 tabs.

38812 (DGMK–300) **Correlation between the high temperature rheology of engine oils and the load bearing capacity of plain bearings in multicylinder engines.** Gerve, A.; Ehinger, M. Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.). Mar 1987. 96p. (In German). Contract AIF 5592. Available from Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.).

The normal specification presently used for the viscosity range of engine oils gives insufficient precise information about the effective viscosity of the oil in a bearing of an operating engine. There is a general recognized assumption, that a clear correlation exists between minimum oil film thickness, roughness and wear in plain bearings with given lubrication properties. Therefore as part of the DGMK research project No. 300 a highly sensitive method should be developed using the radionucleus wear measurement technique which should be suitable for establishing the effective viscosity at which there is onset of wear or for establishing a defined wear limit. The investigations have however shown no clear evidence for the aforementioned correlation in the used test motor at the selected bearing type because the lead-bronze multilayers used lead to surprisingly large scatter in wear behaviour. (orig.) With 30 figs.

38813 (EGG–10617-2014) **A study of the homogeneity and deviations from stoichiometry in mercuric iodide.** Burger, A.; Morgan, S.; He, C.; Silberman, E.; van den Berg, L.; Ortale, C.; Franks, L.; Schieber, M. EG and G, Inc., Goleta, CA (USA). Santa Barbara Operations. 1989. 19p. Sponsored by DOE Defense Programs. DOE Contract AC08-88NV10617. (CONF-890891–1: International organization for crystal growth IOCG, Tokyo, Japan, Aug 1989). Order Number DE89013092/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We have been able to determine the deviations from stoichiometry of mercuric iodide (HgI_2) by using Differential Scanning Calorimetry (DSC). Mercury excess or iodine deficiency in mercuric iodide can be evaluated from the eutectic melting of HgI_2– Hg_2I_2 at 235°C which appears as an additional peak in DSC thermograms. I_2 excess can be found from the existence of the I_2–HgI_2 eutectic melting at 103°C. An additional DSC peak appears in some samples around 112°C that could be explained by the presence of iodine inclusions. Using Resonance Fluorescence Spectroscopy (RFS) we have been able to determine the presence of free I_2 that is released by samples during the heating at 120°C (crystal growth temperature) thus giving additional support to the above DSC results. 19 refs., 6 figs., 2 tabs.

38814 (NUREG/CR–4530-Vol.3) **US/French joint research program regarding the behavior of polymer base materials subjected to beta radiation: Volume 3, Phase-2b expanded test results.** Buckalew, W.H.; Chenion, J.; Carlin, F.; Gaussens, G.; Le Tutour, P.; Le Meur, M. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Sandia National Labs., Albuquerque, NM (USA). Jul 1989. 56p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (SAND–86-0366-Vol.3;IPSN–1/88-Vol.3). Available from NTIS, PC A04/MF A01 - GPO - OSTI.

This document is the final account of a multiyear joint NRC/CEA cooperative research program to investigate the relative effectiveness of beta and gamma irradiations to produce in polymer base electrical insulation and jacket materials. During the program jointly executed by research laboratories in the US (Sandia National Laboratories) and France (Compagnie ORIS Industrie), a number of material and radiation parameters were investigated. Results obtained were reasonably independent of the radiation parameters and most material parameters investigated and would suggest that material damage resulting from electron beam and gamma ray irradiations can be correlated, within limits, on the basis of absorbed radiation dose. 7 refs., 26 figs., 13 tabs.

38815 (PNL-SA–16952) **Acoustic emission technology for space applications.** Friesel, M.A.; Lemon, D.K.; Skorpik, J.R.; Hutton, P.H. Pacific Northwest Lab., Richland, WA (USA). May 1989. 12p. Sponsored by DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-8905178–2: 6. National Aeronautics and Space Administration nondestructive evaluation workshop, Houston, TX, USA, 23-26 May 1989). Order Number DE89014449/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Clearly the structural and functional integrity of space station components is a primary requirement. The combinations of advanced materials, new designs, and an unusual environment increase the need for inservice monitoring to help assure component integrity. Continuous monitoring of the components using acoustic

emission (AE) methods can provide early indication of structural or functional distress, thus allowing time to plan remedial action. The term "AE" refers to energy impulses propagated from a growing crack in a solid material or from a leak in a pressurized pipe or tube. In addition to detecting a crack or leak, AE methods can provide information on the location of the defect and an estimate of crack growth rate and leak rate. 8 figs.

38816 (SAND–89-0338C) **Characterization of neutron radiation damage in GaAs.** Griffin, P.J.; Lazo, M.S.; Luera, T.F.; Kelly, J.G. Sandia National Labs., Albuquerque, NM (USA). 1989. 20p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890723–10: 26. annual conference on nuclear and space radiation effects, Marco Island, FL, USA, 24-28 Jul 1989). Order Number DE89015491/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The NJOY and MARLOWE computer codes are used to characterize neutron damage to GaAs. The fidelity of the components that affect the calculated GaAs damage is examined. The initial defect production is found to be a linear function of the damage energy. Recombination of Frenkel pairs and the distribution of vacancies introduces a non-linearity in the residual defect population with respect to the damage energy. Consideration of the defect recombinations only provides a slight improvement in the agreement between measured and calculated damage in GaAs but does indicate the areas where more work is needed. 35 refs., 9 figs., 3 tabs.

38817 **Testing of nuclear grade lubricants and their effects on A540 B24 and A193 B7 bolting materials.** Czajkowski, C. (Brookhaven National Lab., Upton, NY (US)). v.v of Corrosion '85. National Assoc. of Corrosion Engineers, Houston, TX (1985). (CONF-850311–: National Association of Corrosion Engineers annual meeting and materials performance and corrosion show, Boston, MA, USA, 25-29 Mar 1985).

An investigation performed on eleven common lubricants using SEM/EDS, Notch Tensile tests, frictional testing and weight loss measurements yielded the following general conclusions: (1) there is a significant amount of variance in the mechanical properties of common bolting materials. (2) MoS_2 an hydrolize to form H_2S at 100 C in steam, (3) Cu coating lubricants may be potentially detrimental in aqueous environments to high strength steels.

38818 **Applications of the vibrating probe to localized current measurements.** Isaacs, H. (Brookhaven National Lab., Upton, NY (US)); Ishikawa, Y. v.v of Corrosion '85. National Assoc. of Corrosion Engineers, Houston, TX (1985). (CONF-850311–: National Association of Corrosion Engineers annual meeting and materials performance and corrosion show, Boston, MA, USA, 25-29 Mar 1985).

The basic principles of the vibrating probe and related techniques for measuring variations of current densities in solution are presented. These methods have been applied to the location, monitoring and mechanistics of localized corrosion and the behavior of defects in coatings.

38819 **Nonlinear materials for frequency conversion.** Velsko, S.P. (Nonlinear Optical Materials Group, Lawrence Livermore National Lab., Livermore, CA (US)); Eimerl, D. v.v of Laser optics for intracavity and extracavity applications. Fauchet, P.M.; Guenther, K.H. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-8801107–: Laser optics for intracavity and extracavity applications, Los Angeles, CA, USA, 11-13 Jan 1988).

Two figures of merit, the threshold power (P_{th}) and the limiting volume (V_{min}) can be used to compare the relative efficiency and economy of new harmonic generating crystals. The properties of barium metaborate and L-Arginine phosphate are used to illustrate the effect of nonlinearity, birefringence, and damage threshold on these figures of merit.

38820 **Selective laser-induced photochemical dry etching of semiconductors controlled by ion-bombardment-induced damage.** Ashby, C.I.H. (Sandia National Labs., Albuquerque, NM (US)); Myers, D.R.; Vook, F.L. v.v of Proceedings of the symposium on laser processes for microelectronic applications. Ritsko, J.J.; Ehrlich, D.; Kashiwagi, M. The Electrochemical Society, Pennington, NJ (1988). (CONF-8710331–: Symposium on laser processes for microelectronic applications, Honolulu, HI, USA, 21-22 Oct 1987).

The etch rate of a solid-excitation-based photochemical etching process for semiconductor materials is determined by the balance between recombination of photogenerated carriers and carrier participation in the surface etching reaction. Ion-implantation-induced damage of the semiconductor can shift the balance between recombination and reaction, permitting selective etching of undamaged regions of a semiconductor surface relative to ion-implanted, damaged regions. Spatially selective photochemical dry etching of n-GaAs has been achieved by this approach.

38821 **Effect of the band-gap characteristics on laser-induced dry etching of semiconductors.** Ashby, C.I.H. (Sandia National Labs., Albuquerque, NM (US)); Biefeld, R.M. v.v of Proceedings of the symposium on laser processes for microelectronic applications. Ritsko, J.J.; Ehrlich, D.; Kashiwagi, M. The Electrochemical Society, Pennington, NJ (1988). (CONF-8710331–: Symposium on laser processes for microelectronic applications, Honolulu, HI, USA, 21-22 Oct 1987).

The carrier-driven photochemical dry etching of both direct- and indirect-gap semiconductors depends strongly on the depth of generation of free carriers and the recombination behavior of those carriers. While excitation across the lowest energy gap. E_o, of a direct semiconductor produces many near-surface carriers to drive etching, too few carriers may be generated near the surface by excitation across E_o of an indirect semiconductor for etching to occur. However, excitation across the direct E_1 gap of an indirect semiconductor produces sufficient near-surface carriers for rapid etching. Enhanced bulk carrier recombination in very heavily doped materials can suppress etching in both direct and indirect semiconductors.

38822 **Nonlinear optical and electro-optical properties of strained-layer superlattices grown along the [111] orientation.** Mailhiot, C. (Xerox Webster Research Center, 800 Phillips Rd., Webster, NY (US)); Smith, D.L. v.v of Quantum well and superlattice physics II. Capasso, F.; Dohler, G.; Schulman, J.N. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-8803172–: Quantum well and superlattice physics II, Newport Beach, CA, USA, 17-18 Mar 1988).

Electric polarization fields can be generated by lattice-mismatch induced strain in strained-layer superlattices grown from piezoelectric constituent materials such as III-V semiconductors. The orientation of the polarization fields depends on the superlattice growth axis. For the most commonly studied case of a [100] growth axis, no piezoelectric fields are generated in superlattices made from zincblende-structure constituents. However, for any other growth orientation, these piezoelectric fields do occur. The [111] growth axis presents a particularly interesting case. For this orientation, the polarization fields are parallel to the growth axis. They have opposite polarity in the two constituent materials and can generate large (greater than 10^5 V/cm) internal electrical fields which also have opposite polarity in the two constituent materials. These internal electrical fields strongly modify the electronic structure and optical properties of the superlattice. For example, they change electronic energy levels and wavefunctions and therefore optical transition energies and oscillator strengths. The authors consider cases where the internal fields are modulated by photoabsorption (because the photogenerated carriers screen the fields) and by an externally applied electric field. Large nonlinear optical and electro-optical coefficients occur in [111] growth-axis strained-layer superlattices because of the internal piezoelectric fields.

38823 **On the selection rules for the identification of special interfaces.** Wolf, D. (Argonne National Lab., Argonne, IL (US)). v.v of Electronic packaging materials science. Geiss, E.A.; Tu, K.N.; Uhlmann, D.R. Materials Research Society, Pittsburgh, PA (1985). (CONF-841157–: Materials Research Society annual meeting, Boston, MA, USA, 26-29 Nov 1984).

It is demonstrated that the most important geometrical parameter governing the identification of special interfaces is the interplanar spacing of the lattice planes parallel to the interfacial plane and not, as often assumed, the inverse density of coincident-site lattice points, Σ. A simple geometrical selection rule for the identification of special or favored boundaries is formulated on the basis of the interplanar lattice constant.

38824 Enhanced self-diffusion of water in restricted geometry. D'Orazio, F. (Department of Physics and Astronomy, Northwestern University, Evanston, Illinois 60208(US)); Bhattacharja, S.; Halperin, W. P.; Gerhardt, R. *Physical Review Letters (USA)*, 63(1): 43-46 (3 Jul 1989).

Self-diffusion of water contained in a porous glass is observed to be strongly enhanced if the pore space is only partially filled. This can be explained by a novel mechanism involving indirect molecular exchange between the liquid and the vapor phase. A theoretical model fits the pulsed-field-gradient NMR diffusion measurements with no adjustable parameters. NMR relaxation measurements were performed to provide a characterization of the homogeneity of the samples.

38825 Positron-annihilation studies of the electronic structure of NiO. Wachs, A. L. (Lawrence Livermore National Laboratory, Livermore, California 94550(US)); Turchi, P. E. A.; Howell, R. H.; Jean, Y. C.; Fluss, M. J.; Kaiser, J. H.; West, R. N.; Merkle, K. L.; Revcolevschi, A. *Physical Review [Section] B: Condensed Matter (USA)*, 40(1): 1-9 (1 Jul 1989). DOE Contract W-7405-ENG-48.

We report the first two-dimensional angular correlation ofpositron-annihilation radiation (ACPAR) studies of the positron-electronmomentum distribution for NiO. The data contain two components: a large,isotropic, corelike electron contribution and a remaining valence-electroncontribution. We access the covalency structure by modeling the anisotropy witha linear combination of atomic orbitals–molecular orbital method and alocalized ion scheme, within the independent-particle model. We obtain theexperimental two-dimensional electron-positron *k*-space momentum densityand find no Fermi surface but significant, small residual variations. Theimportance and implications of these results for ACPAR studies of the newhigh-T_c perovskites are discussed.

38826 Steric hindrance effects in atomic layer epitaxy of InAs. Jeong, W. G. (Department of Materials Science, Electrical Engineering and the Center for Photonic Technology, University of Southern California, Los Angeles, California 90089-0483 (US)); Menu, E. P.; Dapkus, P. D. *Applied Physics Letters (USA)*, 55(3): 244-246 (17 Jul 1989).

Atomic layer epitaxy of InAs is demonstrated. Saturation of the growth rate of one monolayer per cycle is achieved at a growth temperature of 340 °C. The growth rate is found to be a strong function of trimethylindium exposure times for the same total amount of reactant exposure per cycle. There is a threshold exposure time to achieve a growth rate of one monolayer per cycle. For shorter exposure time, the growth rate saturates to sub-one monolayer per cycle. The dependence of growth rate on exposure time is explained by steric hindrance effects of the initial adsorbate.

38827 Reply to "Comment on 'Direct observation of relaxation modes in $KNbO_3$ and $BaTiO_3$ using inelastic light scattering' ". Sokoloff, J. P. (Optical Sciences Center, University of Arizona, Tucson, Arizona 85721(US)); Chase, L. L.; Rytz, D. *Physical Review [Section] B: Condensed Matter (USA)*, 40(1): 788-790 (1 Jul 1989).

In the preceding Comment Fontana *et al.* make three assertions basedon experimental facts they believe to be in contradiction with our results, andthen describe results and conclusions of their own recent Raman studies. Inparticular, they show spectra which they believe indicate that there is acoupled relaxation-soft phonon mode of B_2 symmetry inorthorhombic $KNbO_3$. In our Reply we attempt to answer their threeobjections in some detail, and show why we do not believe their objections tobe valid. Additionally we describe the differences between their Ramanmeasurements and ours, which show clearly that there is no evidence of aB_2 relaxation mode in orthorhombic $KNbO_3$, anddiscuss why we think such difference may have occurred.

38828 Stoichiometry-related defects in GaAs grown by molecular-beam epitaxy at low temperatures. Kaminska, M. (Department of Materials Science and Mineral Engineering and Center for Advanced Materials, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720(US)); Weber, E. R.; Liliental-Weber, Z.; Leon, R.; Rek, Z. U. *Journal of Vacuum Science and Technology, B: Microelectronics Processing and Phenomena (USA)*, 7(4): 710-713 (Jul 1989).

GaAs layers grown by molecular-beam epitaxy (MBE) at very low substrate temperatures have gained considerable interest as buffer layers for GaAs metal–semiconductor field effect transistors (MESFET's) due to high resistivity and excellent device isolation. However, the structure and the electronic properties of such layers have not yet been investigated in detail. We have studied unannealed low temperature (LT) MBE layers grown at 200 °C using transmission electron microscopy (TEM), analytical TEM, x-ray diffraction, the Hall effect, and electron paramagnetic resonance (EPR) techniques. TEM data indicated large arsenic-rich deviations from stoichiometry of ~1–1.5 at. %. X-ray rocking curves showed a uniform increase of 0.1% in all directions of lattice parameters compared to semi-insulating GaAs substrate. The Hall effect and thermally induced changes of photo-EPR measurements revealed the presence of an acceptor level at an energy of ~0.3 eV above the valence band. This acceptor level has been tentatively attributed to a gallium vacancy defect.

38829 Ultraviolet photoemission studies of GaAs(100) surfaces chemically stabilized by H_2S treatments. Tiedje, T. (Physics Department, University of British Columbia, Vancouver, British Columbia V6T 2A6(CA)); Colbow, K. M.; Rogers, D.; Fu, Z.; Eberhardt, W. *Journal of Vacuum Science and Technology, B: Microelectronics Processing and Phenomena (USA)*, 7(4): 837-840 (Jul 1989).

We report photoemission studies of GaAs(100) surfaces treated with H_2S. Our high-resolution core level photoemission data show that these surfaces are completely terminated by a GaS_x species and the treated surface is stable in air or water. Thus a H_2S treatment might result in better device quality surfaces and interfaces than the surfaces prepared by recently proposed chemical treatments involving Na_2S or $(NH_4)_2S$.

38830 Investigations of ammonium sulfide surface treatments on GaAs. Carpenter, M. S. (School of Electrical Engineering, Purdue University, West Lafayette, Indiana 47907(US)); Melloch, M. R.; Cowans, B. A.; Dardas, Z.; Delgass, W. N. *Journal of Vacuum Science and Technology, B: Microelectronics Processing and Phenomena (USA)*, 7(4): 845-850 (Jul 1989).

X-ray photoelectron spectroscopy (XPS) and reflection high-energy electron diffraction (RHEED) results are presented for ammonium sulfide treated (100)GaAs surfaces. XPS shows that the sulfur coverage is independent of the ammonium sulfide concentration, although the relative amount of arsenic decreases as the sulfide concentration increases. RHEED patterns show that higher temperatures are required for the surface to restructure following treatment with higher sulfide concentration. In addition to the order of magnitude changes in the diode saturation current densities following ammonium sulfide treatment, we observe that the characteristics of gold and aluminum Schottky barriers on sulfide-treated GaAs surfaces also vary with the substrate temperature during metal deposition.

38831 Structural and electronic properties of Bi/GaAs(110). Ludeke, R. (IBM T. J. Watson Research Center, Yorktown Heights, New York 10598(US)); Taleb-Ibrahimi, A.; Feenstra, R. M.; McLean, A. B. *Journal of Vacuum Science and Technology, B: Microelectronics Processing and Phenomena (USA)*, 7(4): 936-944 (Jul 1989).

Ordered Bi overlayers on GaAs(110) were investigated with scanning tunneling microscopy (STM), STM spectroscopy, low-energy electron diffraction (LEED) studies, and with angle-integrated and angle-resolved photoemission spectroscopies. Two-dimensional (2D) layer growth occurs to ~1 monolayer (ML), thereafter three-dimensional (3D) growth dominates. A Bi phase pseudomorphic with the GaAs is observed to ~10 ML. Interdiffusion or chemical reactions between the components were not detected. STM images for coverages of 0.5 and 1 ML reveal the Bi structure to consist of chains of atoms aligned above and in between the Ga–As zigzag surface chains. Additional evidence for dual bonding sites of the Bi suggests that the Bi chains exhibit a zigzag structure similar to the Sb/GaAs system. Near 1 ML the Bi chains are interrupted by a periodic array of dislocations, ~25 A apart, that consist of missing Bi atoms. STM spectroscopy reveals that the Bi ML is semiconductor-like with a 0.7-eV band gap, and that the dislocations generate a band of empty, acceptorlike states within this gap. Band bending measurements indicate that the position of the Fermi level on *n*-type

GaAs is determined by these acceptor states. Gap states were also associated with Bi terrace edges for coverages <1 ML. The position of the Fermi level for Bi on *p*-type GaAs is determined by the top of the Bi valence band, which overlaps that of GaAs by 0.4 eV. The dispersion of this band and another lower Bi band were measured using angle resolved photoemission spectroscopy.

38832 Annealing Ag on GaAs: Interplay between cluster formation and Fermi level unpinning. Chiang, T. T. (Stanford Electronics Laboratories, Stanford University, Stanford, California, 94305(US)); Wahi, A. K.; Lindau, I.; Spicer, W. E. *Journal of Vacuum Science and Technology, B: Microelectronics Processing and Phenomena (USA),* 7(4): 958-963 (Jul 1989).

It has been shown that upon annealing a 2-monolayer coverage of Ag on UHV-cleaved GaAs at 500 °C, the Ag clusters into islands and the surface Fermi level moves back to within 0.2 eV of the bulk position. In this study, this Fermi level unpinning behavior has been investigated further by using various substrate doping levels and varying the anneal temperature. The Ag clustering process was observed using both ultraviolet photoelectron spectroscopy (UPS) and scanning electron microscopy. Through UPS, the surface Fermi level (E_{fs}) movement was monitored simultaneously with the clustering process. No distinct temperature for the onset of clustering is observed. Rather, the clustering process occurs continuously over the range of temperatures studied (room temperature to 500 °C), with the Ag clusters growing and increasing in separation as anneals are performed at successively higher temperatures. A 10 min annealing time was sufficient to achieve a stable, equilibrium configuration at each annealing temperature. Movement of the E_{fs} back to near the bulk position occurred between 375–450 °C for high doped *n*-GaAs (6×10^{18}/cm^3); whereas no movement of the E_{fs} was observed for low doped *n*-GaAs (4×10^{16}/cm^3) up to 475 °C. Similar results were obtained when the experiment was repeated for high doped *p*-GaAs (1.4×10^{19}/cm^3) and low doped *p*-GaAs (5×10^{16}/cm^3). The absence of movement of E_{fs} in the low doped GaAs is attributed to the longer substrate depletion length, implying that only the areas beneath and within the depletion length of the Ag clusters are pinned.

38833 Abrupt interfaces on InP(110): Cases of Sb and Sn. Kendelewicz, T. (Stanford Electronic Laboratories, Stanford University, Stanford, California 94305(US)); Miyano, K.; Cao, R.; Lindau, I.; Spicer, W. E. *Journal of Vacuum Science and Technology, B: Microelectronics Processing and Phenomena (USA),* 7(4): 991-996 (Jul 1989).

The formation of the Sb and Sn/InP(110) interfaces has been studied *in situ* by soft x-ray core level photoemission spectroscopy. It is found that in both cases the growth of the first uniform monolayer is followed by the formation of large overlayer islands (Stranski–Krastanov mode). The dramatic sharpening of the substrate core levels at one monolayer of Sb indicates the formation of an ordered epitaxial overlayer. No such effect is seen for Sn for which the In 4*d* core level shows an indication of surface disruption. Despite the lack of order, this interface also remains mostly nonreactive. A straightforward analysis of the data for these particularly simple interfaces indicates nonequivalent shifts in the P 2*p* and In 4*d* core levels which are taken as a measure of the band bending. The origin of this discrepancy is shown to be related to an additional interface component in the In 4*d* core level data. The results of this study indicate that even for nonreactive InP interfaces one must take this into account in using core level photoemission data for quantitative band bending determination. Interestingly, both Sb and Sn, although nonreactive, appear to form Ohmic contacts to InP(110).

38834 Atomic arrangement at Cr/GaAs(110) interfaces. Liliental-Weber, Z. (Center for Advanced Materials, Lawrence Berkeley Laboratory, Berkeley, California 94720(US)); O'Keefe, M. A. *Journal of Vacuum Science and Technology, B: Microelectronics Processing and Phenomena (USA),* 7(4): 1022-1026 (Jul 1989). DOE Contract AC03-76SF00098.

To further explore the mechanism of Schottky barrier formation at a metal–semiconductor interface, high-resolution electron micrographs were simulated in order to interpret the contrast observed experimentally at Cr/GaAs(110) interfaces. Calculations for a wide range of defocus and sample thickness values, based on an assumed ideal arrangement of atoms at the interface, do not explain the observed contrast. Analytical data suggest that the interface is As rich. In this paper, therefore, only those point defects that lead to As-rich interfaces were considered. Among such point defects, Ga vacancies seem likely to contribute to such experimentally observed contrast.

38835 Simple approach to stimulated Brillouin scattering in glass aerosols. Chitanvis, S. M. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545 (US)); Cantrell, C. D. *Journal of the Optical Society of America B: Optical Physics (USA),* 6(7): 1326-1331 (Jul 1989).

We have investigated the effects of stimulated Brillouin scattering on a transparent, spherical bead with a radius of the order of 25 μm, the wavelength of the incident laser being $\sim$1 μm. We have used a simple approach with intuitive appeal that displays the fundamental physics. We consider two cases: (a) neither the pump field nor the Stokes field is on a Mie resonance of the spherical transparent bead; (b) both the pump field and the Stokes field are resonant. We derive explicit expressions for the electromagnetic differential scattering cross sections, using the Lippman–Schwinger equation for scalar electromagnetic field equations. Mie theory is utilized to estimate the occurrence of Mie resonances as the size parameter $x=2\pi a/\lambda$ is varied. We give quantitative estimates of the fraction of droplets expected to shatter owing to resonant stimulated Brillouin scattering in a polydisperse distribution.

38836 First-principles calculation of the formation energies of ordered and disordered phases of AlAs-GaAs. Christensen, N. E. (Max-Planck-Institut fur Festkorperforschung, Postfach 806065, D-7000 Stuttgart 80, Federal Republic of Germany(DE)); Wei, S.; Zunger, A. *Physical Review [Section] B: Condensed Matter (USA),* 40(3): 1642-1646 (15 Jul 1989).

The total energy of ordered and disordered phases of AlAs-GaAs systems is expanded in a series of multiatom interaction energies determined from first-principles linear muffin-tin orbital and linear augmented-plane-wave calculations of simple superstructures. These interaction energies are used to discuss the stability of different superlattices and that of the random alloy.

38837 Amplitude breathers in conjugated polymers. Phillpot, S. R. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439(US)); Bishop, A. R.; Horovitz, B. *Physical Review [Section] B: Condensed Matter (USA),* 40(3): 1839-1855 (15 Jul 1989). DOE Contract W-31-109-ENG-38.

Nonlinear adiabatic dynamics of electron-phonon models of *trans*-$(CH)_x$, *cis*-$(CH)_x$, and $(AB)_x$-type polymers are studied. Using both analytic low-amplitude expansion and numerical simulations, we find the existence of charge-neutral breathers—spatially localized, time-periodic nonlinear excitations. Simulations also show that a photoexcited electron-hole pair generates a breather in addition to a soliton-antisoliton pair. Semiclassical quantization shows that the *n*th breather is a bound state of *n* amplitude phonons. A semiclassical formalism of optical absorption is applied to *trans*-$(CH)_x$; the ground-state result accounts for a pronounced intragap absorption tail, while breathers can account for the observed photoinduced absorption at 1.35 eV.

38838 Hall mobility of electrons in liquid and solid argon. Ascarelli, G. (Department of Physics, Purdue University, West Lafayette, Indiana 47907(US)). *Physical Review [Section] B: Condensed Matter (USA),* 40(3): 1871-1879 (15 Jul 1989).

The Hall mobility of electrons injected in liquid argon has been measured along the liquid-vapor coexistence line, along a portion of the 50-atm isobar, and in the solid at the triple point. From a comparison of these results with the published time-of-flight (TOF) mobility data, it is concluded that the low-field TOF data in the liquid coincide with the low-field drift mobility. From a comparison of the ratio of the Hall and TOF mobilities with its counterpart calculated on the basis of different models, it is concluded that only the model in which the scattering is due to both phonons and nearly static density fluctuations can explain the experimental data. There is excellent agreement between the mobility observed in the solid (2820 cm^2/V s) and what one would expect if the calculated phonon scattering in the liquid would be extrapolated to the density of the solid. This provides support for the density-dependent effective mass that was used as a parameter in the model calculation. What remains unexplained, in the framework of a single spherical parabolic band,

is the magnetic field dependence of the Hall angle near the mobility maximum.

38839 Field dependence of the nuclear magnetic resonance static powder line shape: Studies of the mutual orientation of interaction tensors from the field dependence of the critical frequencies. Chu, P. J. (Department of Chemistry, Iowa State University, Energy and Mineral Resources Research Institute, Ames, Iowa 50011(US)); Gerstein, B. C. *Journal of Chemical Physics (USA)*, 91(4): 2081-2101 (15 Aug 1989).

A procedure for determining the interaction tensor orientations and the interaction parameters for mutually oriented electric field gradient (efg) or dipolar and shielding tensors has been developed based upon the magnetic field dependence of the critical frequencies from the polycrystalline nuclear magnetic response (NMR) spectrum. The central transition line shape of half-integer quadrupolar nuclei in the presence of mutually oriented shift anisotropy and second order quadrupolar interaction is discussed for the first time. Analytical expressions for the field dependent critical frequencies have been determined for special orientations when the shift principal *Z* axis lies on the *XZ*, *YZ*, or *XY* plane of the efg (or dipolar) tensor for the first order as well as the second order interactions. The plots resulting from the analytical expressions provide a convenient graphical approach in determining approximate tensorial orientations and interaction parameters through pattern recognition. For general orientations, a numerical procedure has been developed to determine these parameters by iteratively minimizing the squares of the differences of the calculated and the experimental critical frequencies. Higher order perturbation terms can be incorporated in the present treatment. The method is demonstrated by variable field static proton spectra of trichloro–acetic acid at three different fields (1.3, 2.3, 5.2 T). The near-orthogonal orientation between the dipolar and shielding tensors and the interaction parameters obtained from this approach are consistent with those obtained previously from single crystal studies.

38840 Method for fabricating light weight carbon-bonded carbon fiber composites. Wrenn, G.E. Jr.; Abbatiello, L.A.; Lewis, J. Jr. To Dept. of Energy, Washington, DC. USA Patent 4,818,448. 4 Apr 1989. Filed date 17 Jun 1987. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

Ultralight carbon-bonded fiber composites of densities in the range of about 0.04 to 0.10 grams per cubic centimeter are fabricated by forming an aqueous slurry of carbonaceous fibers which include carbonized fibers and 0-50 weight percent fugitive fibers and a particulate thermosetting resin precursor. The slurry is brought into contact with a perforated mandrel and the water is drained from the slurry through the perforations at a controlled flow rate of about 0.03 to 0.30 liters per minutes per square inch of mandrel surface. The deposited billet of fibers and resin precursor is heated to cure the resin precursor to bind the fibers together, removed from the mandrel, and then the resin and fugitive fibers, if any, are carbonized.

38841 Random access memory immune to single event upset using a T-resistor. Ochoa, A. Jr. To Dept. of Energy, Washington, DC. USA Patent 4,809,226. 28 Feb 1989. Filed date 28 Oct 1987. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

In a random access memory cell, a resistance T decoupling network in each leg of the cell reduces random errors caused by the interaction of energetic ions with the semiconductor material forming the cell. The cell comprises two parallel legs each containing a series pair of complementary MOS transistors having a common gate connected to the node between the transistors of the opposite leg. The decoupling network in each leg is formed by a series pair of resistors between the transistors together with a third resistor interconnecting the junction between the pair of resistors and the gate of the transistor pair forming the opposite leg of the cell.

40 CHEMISTRY

38842 (ANL–89/15) Chemical Technology Division annual technical report, 1988. Argonne National Lab., IL (USA). May 1989. 207p. Sponsored by DOE/CE;DOE/FE;DOE/NE. DOE Contract W-31109-ENG-38. Order Number DE89013917/JAW. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

Highlights of the Chemical Technology (CMT) Divisions's activities during 1988 are presented. In this period, CMT conducted research and development in the following areas: (1) high-performance batteries (mainly lithium-alloy/metal sulfide, sodium/metal chloride, and sodium/sulfur); (2) aqueous batteries (lead-acid, nickel/iron, etc.); (3) advanced fuel cells with molten carbonate or solid oxide electrolytes; (4) coal utilization, including the heat and seed recovery technology for coal-fired magnetohydrodynamics plants and the technology for fluidized-bed combustion; (5) methods for recovery of energy from municipal waste and techniques for treatment of hazardous chemical water; (6) nuclear technology related to a process for separating and recovering transuranic elements from nuclear waste and for producing ^{99}Mo from low-enriched uranium targets, the recovery processes for discharged fuel and the uranium blanket in a sodium-cooled fast reactor, and waste management; and (7) physical chemistry of selected materials in environments simulating those of fission and fusion energy systems. The Division also has a program in basic chemistry research in the areas of fluid catalysis for converting small molecules to desired products; materials chemistry for superconducting oxides and associated and ordered solutions at high temperatures; interfacial processes of importance to corrosion science, high-temperature superconductivity, and catalysis; and the geochemical processes responsible for trace-element migration within the earth's crust. The Division continued to be the major user of the technical support provided by the Analytical Chemistry Laboratory at ANL. 53 figs., 16 tabs.

38843 (LA–11600-PR) Chemical and Laser Sciences Division annual report, 1988. Los Alamos National Lab., NM (USA). Jun 1989. 114p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-36. Order Number DE89014385/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This annual report from the Chemical and Laser Sciences Division at Los Alamos contains both programmatic and technical information on the following research: KrF lasers for inertial confinement fusion; free electron lasers; neutral particle beam sensing; chemical sensing; mass spectroscopy; orbit simulations; high temperature kinetics; and microwave absorption spectrometers. (JEF)

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Refer also to citation(s) 37855, 37879, 37904, 37906, 37911, 37913, 37917, 38097, 38101, 38906, 39166

38844 (CEA-CONF–9765) Membrane separation methods compared to thermal processes. Lecomte, C. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie. 1988. 9p. (In French). (CONF-8805300–: Meeting of the French Society of the Heat Engineers, Paris-La-Defense, France, 31 May 1988). Order Number DE89781455/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

Gas permeation is a separation technique through polymer membranes and powered by pressure gradient. Improvement of membrane performance extends their use to new applications: oxygen enriched air production (energy recovery), nitrogen production for inert atmosphere (fuel storage) and dehydration of petroleum gases.

38845 (CEA-R–5482) Program for measuring plutonium quantities by gamma spectrometry: code 'PUMA'. Morel, J.; Vallee, M.; Etcheverry, M. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Office des Rayonnements Ionisants. 1989. 70p. (In French). Order Number DE89791946/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The interest of the gamma spectrometry method for measuring plutonium quantities has been recently demonstrated. A practical outcome of this study is the code 'PUMA' (PlUtonium MAss). This code, characterized by an easy utilisation, is operational on a microcomputer. It can be used for the hold-up measurements, monitoring of wastes and surveillance of facility dismantling. The general structure, subroutine algorithms, the principles used for calculating parameters and corrections are explained.

38846 (CEA-R-5483) **Energy dispersive X ray fluorescence with graphite monochromator - uranium and plutonium analyses in aqueous or organic media.** Berthoud, T.; Delorme, N.; Delorme, P.; Iaremenko, M. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI). 1989. 120p. (In French). Order Number DE89791945/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

We describe an energy dispersive X ray fluorescence apparatus equipped with a cylinder graphite monochromator developed in our laboratory. The graphite monochromator is inserted between the sample and the detector, it permits the selection of the fluorescence X radiation from the sample before collection by the Si-Li diode. Hence, the signal versus noise ratio of the fluorescence peak is increased and the limit of detection of our apparatus for uranium is 0.1 mg/l. This apparatus is perfectly adapted for the L rays of all the transuranium elements determinations. We also demonstrate the possibility of determination of uranium or plutonium in either aqueous or organic (TBP) phase. This apparatus is well adapted to control low levels of uranium and plutonium solutions originating from Purex process.

38847 (GKSS–88/E/66) **Experience in 14 MeV neutron activation analysis using short lived nuclides.** Pepelnik, R. GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). 1988. 25p. Available from Special print from J. Trace and Microprobe Techniques (1988) v. 6(2) p. 271-294.

14 MeV neutron activation analysis (NAA) using short-lived isotopes has an important potential for the detection of elements. Prerequisites are therefore a high-intensity neutron generator (like KORONA with a useable fast neutron flux of 3.10^{14} n/m^2 s), a fast rabbit system suitable for cyclic irradiations and measurements, and a gamma-ray spectrometry system with real-time correction of counting losses. Applying such a system for more than 30 elements, analytical sensitivities below 50 μg have been deduced, using produced nuclides with half-lives below 1 min. All important parameters for analysis, such as reaction cross sections, elemental interferences, neutron flux and detector efficiency have been investigated. 14 MeV NAA using short irradiation times has been applied to the investigation of soil, sediment, metallic materials and air dust. An overall accuracy in analysis of about 3% has been achieved. (orig.).

38848 (IGCAR–79) **Trace characterisation of tin-bismuth alloy by optical emission spectrography.** Srinivasan, V.; Krishna Prabhu, R.; Mahalingam, T.R. Indira Gandhi Centre for Atomic Research, Kalpakkam (India). 1986. 17p. Order Number DE89630798/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

An emission spectrographic method has been developed for the determination of eighteen impurities in a tin-bismuth alloy sample. The metal alloy is converted to its oxide form and mixed with pure graphite in the ratio 2:1. 20mg of this mixture taken in a 1/4inch dia graphite electrode, is excited in nitrogen atmosphere using a 10 amp d.c. arc. The spectra of the samples are photographed using a 3.4M Ebert spectrograph with a 1180 grooves/mm grating. The concentration range covered are between 0.1ppm and 1000ppm for various elements and the precision of the method is found to be about 18 per cent. (author). 4 tabs., 6 figs.

38849 (IGCAR–80) **Determination of the composition of alloying elements in stainless steel by solution spark technique.** Srinivasan, V.; Krishna Prabhu, R.; Mahalingam, T.R. Indira Gandhi Centre for Atomic Research, Kalpakkam (India). 1986. 12p. Order Number DE89630799/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A method has been developed for the simultaneous determination of chromium, nickel, manganese and molybdenum in stainless steel using the rotating disc graphite electrode. The alloy is dissolved in sulphuric acid and a 4 mg/ml solution is taken in a porcelain boat. The rotating disc electrode with its rim kept dipped in the solution, fed the sample continuously to the spark plasma. The resulting spectra are photographed using the 3.4M Ebert grating spectrograph. The precision of the method is found to be around 5 per cent. (author). 5 refs., 4 tabs.

38850 (IGCAR–87) **Determination of oxygen in sodium by the vacuum distillation method.** Ganesan, V.; Krishnamoorthy, D.; Bhat, N.P. Indira Gandhi Centre for Atomic Research, Kalpakkam (India). 1986. 16p. Order Number DE89630800/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This report describes in detail the vacuum distillation method for determination of oxygen in sodium metal. Sodium oxide is separated from sodium by vacuum distillation of the latter under high vacuum in a glass distillation vessel with induction heating. The sodium content of the residue after distillation is estimated by titration or by flame emission spectrometry and equivalent oxygen content calculated. The method is applicable to estimation of as low as 1 ppm oxygen in sodium, potassium and NaK.

38851 (IGCAR–88) **Determination of chloride in sodium metal.** Sahasranaman, S.; Swaminathan, K.; Bhat, N.P. Indira Gandhi Centre for Atomic Research, Kalpakkam (India). 1986. 11p. Order Number DE89630801/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The report describes in detail a simple method adopted for estimation of trace levels of chloride in sodium metal. Sodium matrix is separated from the chloride by vacuum distillation of sodium and the residue is analysed for chloride by the mercuric thiocyanate colorimetric method. There was no loss of chloride during the distillation process as shown by the results of standard addition experiments. This method gives better sensitivity and precision over the conventional method.

38852 (IGCAR–92) **New inexpensive electrochemical meter for oxygen in sodium coolant.** Periaswami, G.; Rajan Babu, S.S.; Mathews, C.K. Indira Gandhi Centre for Atomic Research, Kalpakkam (India). 1987. 21p. Order Number DE89630802/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This report describes the development of an inexpensive oxygen meter for sodium coolant and gives the results of the test experiments. Calcia stabilized zirconia has been found to have necessary domain boundary characteristics at low temperatures for use as oxygen sensor in liquid sodium system. It is possible to obtain acceptable sensor cell resistance at temperatures as low as 230 C if K, K_2O or Na, Na_2O is used as reference electrode. The performance of these cells has been tested in bench top sodium loops over long periods. Their performance in terms of cell-out put variation with change in oxygen concentration in sodium has been found to be satisfactory. They also have sufficiently long life times since the kinetics of sodium attack on the electrolyte is slow at low temperatures. (author). 17 refs., 6 figs.

38853 (IGCAR–95) **Compositional analysis of steels by x-ray fluorescence spectrometry.** Kutty, K.V.G.; Rajagopalan, S.; Ananthakrishnan, S.K.; Asuvatharaman, R. Indira Gandhi Centre for Atomic Research, Kalpakkam (India). 1988. 25p. Order Number DE89630803/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The x-ray fluorescence spectrometric method of determining Ni, Cr, Mn, Mo, Ti, Si and Co in austenitic, ferritic, titanium-stabilised and low alloy steels is described. Samples in the bulk solid form (25-50 mm diameter and upto 50 mm height) or very small samples having a flat surface at least 5 mm in diameter are analysed as received after a brief surface treatment. The complex matrix effects affecting the determination of the various elements are discussed. The direct calibration method as well as the mathematical method of empirical coefficients of overcoming the matrix effects is described. The precision and accuracy of the analyses are discussed. (author). 10 refs.

38854 (INIS-mf–11440, pp. 38-39) **Elemental analysis in a bi-component matrix without standard, by charged particle activation.** Cincu, Em. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering). Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics*. Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

A method is proposed for analyzing samples composed by two major components by using recent precise data of charged particle yield and without any standard.

38855 (INIS-mf–11440, pp. 82-83) **Analysis of impurities content in a platinum sample by neutron activation method.** Pantelica, A. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering); Salagean, M. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

By instrumental neutrn activation analysis at VVRS reactor of Bucharesct, the level of 0.1-3 ppm concentration for Ag,Au, Ir, Os,Rh and Zn impurities in a high purity platinum matrix have been determined. (authors).

38856 (INIS-mf–11440, pp. 86) **Determination of heavy metal (Fe, Cu, Zn, Ni, Pb) contents in ion exchangers by gamma spectrometry and atomic absorption spectrometry.** Pencea, C. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering); Fodor, G.; Paraschiv, M.; Alexan, Z. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Weighed samples of a dried ion exchanger were neutron irradiated for variable periods of time. Gamma spectra were obtained. (authors).

38857 (INIS-mf–11440, pp. 97-98) **Method of gamma spectroscopic dta acquisition by soft simulating of the functions of counter/timer module.** Rotileanu, N. (ICPE, Bucharest, Romania). Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Experimental data measured by a detection system are transferred to microcomputer through the soft simulation.

38858 (INIS-mf–11440, pp. 164-165) **Boron isotope content determination by thermal ionisation mass spectrometry.** Pamula, A (Institutul de Tehnologie Izotopica si Moleculara, Cluj-Napoca (Romania)); Fatu, C. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

In spite of the high ionization potential of boron it is possible to achieve isotopic analysis of this element on the $Na_2BO^+_2$ ion arising by thermal decomposition of $Na_2B_4O_7$ molecule. (authors).

38859 (INIS-mf–11440, pp. 656) **Radiochemical determination of I-131 in water.** Spiridon, S. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering); Alexan, Z. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

A method based on a Dowex 50x8, Oh^- form Dowex 50x12 H^+ form mixed column was developed. (authors).

38860 (INIS-mf–11459) **Summary of Work.** International Atomic Energy Agency, Vienna (Austria). Oct 1987. V (In Spanish). Order Number DE89012192/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Individual papers are processed separately for the data base. (DLC)

38861 (INIS-mf–11459, pp. 32) **Analysis of Si, Al, Fe and Mg using 14MeV neutron activation analysis.** Lopez K, M. (Instituto Peruano de Energia Nuclear, Lima (Peru)); Poma R, C.; Espinosa G, R. Sociedad Quimica del Peru, Lima (Peru). Oct 1987. (In Spanish). (CONF-8710479–: 15. Peruvian Congress of Chemistry, Lima (Peru), 12-17 Oct 1987). In *Resumenes de los trabajos.* Order Number DE89012192/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

ALUMINIUM/activation analysis; IRON/activation analysis; MAGNESIUM/activation analysis; SILICON/activation analysis; ALUMINIUM; IRON; MAGNESIUM; NEUTRONS; NEUTRON SOURCE FACILITIES; SILICON

38862 (INIS-mf–11459, pp. 32) **Non destructive determination of oxygen using 14MeV neutron activation analysis.** Espinosa, R. (Instituto Peruano de Energia Nuclear, Lima (Peru)); Arbildo, A.; Eyzaguirre, J. Sociedad Quimica del Peru, Lima (Peru). Oct 1987. (In Spanish). (CONF-8710479–: 15. Peruvian Congress of Chemistry, Lima (Peru), 12-17 Oct 1987). In *Resumenes de los trabajos.* Order Number DE89012192/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

OXYGEN/activation analysis; FAST NEUTRONS; NEUTRONS; OXYGEN

38863 (INIS-mf–11459, pp. 31) **Uranium determination in samples with high copper content.** Torres, B. (Instituto Peruano de Energia Nuclear, Lima (Peru)); Quispe, R.; Chinchay, L. Sociedad Quimica del Peru, Lima (Peru). Oct 1987. (In Spanish). (CONF-8710479–: 15. Peruvian Congress of Chemistry, Lima (Peru), 12-17 Oct 1987). In *Resumenes de los trabajos.* Order Number DE89012192/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

URANIUM COMPOUNDS/solvent extraction; URANIUM SULFATES/fluorescence spectroscopy; COPPER COMPOUNDS; COPPER SULFATES; LEACHING; URANIUM

38864 (INIS-mf–11471) **Abstracts of the colloquium 'separation processes in radiochemical practice'.** Chemische Gesellschaft der DDR, Berlin (German Democratic Republic); Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic). 1988. 6p. (In German). (CONF-8811239–: Colloquium on on separation processes in radiochemical practice, Dresden, German Democratic Republic, 8 Nov 1988). Order Number DE89630813/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

At the national one day colloquium on 'Separation processes in radiochemical practice' dedicated to the 50th anniversary of the discovery of nuclear fission by Hahn and Strassmann 14 papers were read, 11 of them by staff members of the ZfK Rossendorf (GDR). Emphasis was laid on problems of fission product separation and of the behavior of corrosion products.

38865 (INIS-mf–11471, pp. 4) **Ash content determination of cokes with low ash content.** Wagner, K. (Akademie der Wissenschaften der DDR, Berlin (German Democratic Republic). Inst. fuer Chemische Technologie); Prutschin, F.; Menzel, M.; Kraus, B.; Ritter, I.; Goldstein, S. Chemische Gesellschaft der DDR, Berlin (German Democratic Republic); Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic). 1988. (In German). (CONF-8811239–: Colloquium on on separation processes in radiochemical practice, Dresden, German Democratic Republic, 8 Nov 1988). In *Abstracts of the colloquium 'separation processes in radiochemical practice'.* Order Number DE89630813/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

ASHES/activation analysis; COKE/ash content; ASHES; CALIFORNIUM 252; COKE; HALF-LIFE; NAI DETECTORS; NEUTRONS; RADIOACTIVITY; RADIOMETRIC ANALYSIS

38866 (INIS-mf–11471, pp. 1) **Radiochemical separation processes in changing times.** Muenze, R. (Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic)). Chemische Gesellschaft der DDR, Berlin (German Democratic Republic); Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic). 1988. (In German). (CONF-8811239–: Colloquium on on separation processes in radiochemical practice, Dresden, German Democratic Republic, 8 Nov 1988). In *Abstracts of the colloquium 'separation processes in radiochemical practice'.* Order Number DE89630813/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

RADIOCHEMISTRY/separation processes; ELECTROCHEMISTRY; MICROANALYSIS; RADIOCHEMISTRY; RADIOCHROMATOGRAPHY; RADIUM ISOTOPES

38867 (INIS-mf–11471, pp. 2) **Separation of the fission product nuclides ^{89}Sr, ^{90}Sr and ^{140}Ba from grass samples.** Niese, U.

(Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic)); Niese, S. Chemische Gesellschaft der DDR, Berlin (German Democratic Republic); Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic). 1988. (In German). (CONF-8811239–: Colloquium on on separation processes in radiochemical practice, Dresden, German Democratic Republic, 8 Nov 1988). In *Abstracts of the colloquium 'separation processes in radiochemical practice'.* Order Number DE89630813/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

BARIUM 140/separation processes; GRASS/sample preparation; STRONTIUM 89/separation processes; STRONTIUM 90/separation processes; BUTYRIC ACID; CATIONS; CESIUM 134; CESIUM 137; CHERNOBYLSK-4 REACTOR; FISSION PRODUCTS; GRASS; HYDROXY ACIDS; IODINE 131; ION EXCHANGE; LANTHANUM 140; REACTOR ACCIDENTS

38868 (INIS-mf–11471, pp. 3) **Determination of Pu in process solutions of fission molybdenum production.** Huebener, S. (Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic)). Chemische Gesellschaft der DDR, Berlin (German Democratic Republic); Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic). 1988. (In German). (CONF-8811239–: Colloquium on on separation processes in radiochemical practice, Dresden, German Democratic Republic, 8 Nov 1988). In *Abstracts of the colloquium 'separation processes in radiochemical practice'.* Order Number DE89630813/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

FISSION PRODUCTS/ion exchange; PLUTONIUM/quantitative chemical analysis; ALPHA SPECTROSCOPY; ANIONS; ISOTOPE DILUTION; PLUTONIUM; SEPARATION PROCESSES

38869 (INIS-mf–11471, pp. 3) **Application of tracers in process developments of liquid-liquid extraction.** Cloe, K. (Akademie der Wissenschaften der DDR, Dresden (German Democratic Republic). Zentralinstitut fuer Festkoerperphysik und Werkstofforschung); Muehl, P. Chemische Geselischaft der DDR, Berlin (German Democratic Republic); Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic). 1988. (In German). (CONF-8811239–: Colloquium on on separation processes in radiochemical practice, Dresden, German Democratic Republic, 8 Nov 1988). In *Abstracts of the colloquium 'separation processes in radiochemical practice'.* Order Number DE89630813/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

SOLVENT EXTRACTION/tracer techniques; ZINC/waste water; HYDROMETALLURGY; VISCOSE; ZINC

38870 (INIS-mf–11471, pp. 3) **Determination of the separation of rare earths from a perovskite concentrate.** Wagner, K. (Akademie der Wissenschaften der DDR, Berlin (German Democratic Republic). Inst. fuer Chemische Technologie); Menzel, M.; Keil, I.; Ritzmann, A. Chemische Gesellschaft der DDR, Berlin (German Democratic Republic); Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic). 1988. (In German). (CONF-8811239–: Colloquium on on separation processes in radiochemical practice, Dresden, German Democratic Republic, 8 Nov 1988). In *Abstracts of the colloquium 'separation processes in radiochemical practice'.* Order Number DE89630813/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

OXIDE MINERALS/filtration; RARE EARTHS/oxide minerals; ALUMINIUM 28; CALCIUM OXIDES; CALIFORNIUM 252; CERIUM 141; DECOMPOSITION; ELEMENT ABUNDANCE; GAMMA SPECTROSCOPY; LANTHANUM 140; MANGANESE 56; NATURAL RADIOACTIVITY; NEUTRONS; ACTIVATION ANALYSIS; NITRIC ACID; FILTRATION; QUANTITATIVE CHEMICAL ANALYSIS; THORIUM; TITANIUM OXIDES; PEROVSKITES

38871 (INIS-mf–11471, pp. 4) **High-efficiency separation of Eu from Ga using ion exchange on solid $SrSO_4$ following electrochemical reduction to Eu^{2+}.** Mende, A. (Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic)). Chemische Gesellschaft der DDR, Berlin (German Democratic Republic); Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic). 1988. (In German). (CONF-8811239–: Colloquium on on separation processes in radiochemical practice, Dresden, German Democratic Republic, 8 Nov 1988). In *Abstracts of the colloquium 'separation processes in radiochemical practice'.* Order Number DE89630813/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

EUROPIUM/impurities; GADOLINIUM/ion exchange chromatography; ADSORPTION; ELECTROCHEMISTRY; EUROPIUM; IMPURITIES; EUROPIUM 152; EUROPIUM 154; GADOLINIUM; SEPARATION PROCESSES; STRONTIUM SULFATES

38872 (INIS-mf–11471, pp. 6) **Studies on the deposition behavior of Co in the high-pressure temperature loop ELLI under different hydrochemical conditions.** George, G. (Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic)); Glaubitz, W.; Hoffmann, W.; Kelm, H.; Nebel, D.; Schlenkrich, H. Chemische Gesellschaft der DDR, Berlin (German Democratic Republic); Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic). 1988. (In German). (CONF-8811239–: Colloquium on on separation processes in radiochemical practice, Dresden, German Democratic Republic, 8 Nov 1988). In *Abstracts of the colloquium 'separation processes in radiochemical practice'.* Order Number DE89630813/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

COOLANT LOOPS/cobalt 58; COOLANT LOOPS/cobalt 60; CORROSION PRODUCTS; DEPOSITION; FISSION PRODUCT RELEASE; PRIMARY COOLANT CIRCUITS; SOLUTIONS

38873 (LA-UR–89-1935) **Intense x-ray machine for penetrating radiography.** Lucht, R.A.; Eckhouse, S. Los Alamos National Lab., NM (USA). 1989. 16p. Sponsored by Department of Defense. DOE Contract W-7405-ENG-36. (CONF-890885–6: Flash radiography topical symposium, Portland, OR (USA), 15-18 Aug 1989). Order Number DE89014048/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Penetrating radiography has been used for many years in the nuclear weapons research programs. In frequently penetrating radiography has been used in conventional weapons research programs. For example the Los Alamos PHERMEX machine was used to view uranium rods penetrating steel for the GAU-8 program, and the Ector machine was used to see low-density regions in forming metal jets. The armor/anti-armor program at Los Alamos has created a need for an intense flash x-ray machine that can be dedicated to conventional weapons research. The Balanced Technology Initiative, through DARPA, has funded the design and construction of such a machine at Los Alamos. It will be an 8- to 10-MeV diode machine capable of delivering a dose of 500 R at 1 m with a spot size of less than 5 mm. The machine used an 87.5-stage low-inductance Marx generator that charges up a 7.4-Ω, 32-ns water line. The water line is discharged through a self-breakdown oil switch into a 12.4-Ω water line that rings up the voltage into the high-impendance x-ray diode. A long (233-cm) vacuum drift tube is used to separate the large-diameter oil-insulated diode region from the x-ray source area that may be exposed to high overpressures by the explosive experiments. The electron beam is self-focused at the target area using a low-pressure background gas. 15 refs., 11 figs.

38874 (LA-UR–89-1936) **Radiographic study for sympathetic detonation of 500-lb bombs.** Lucht, R.A. Los Alamos National Lab., NM (USA). 1989. 13p. Sponsored by Department of Defense. DOE Contract W-7405-ENG-36. (CONF-890885–5: Flash radiography topical symposium, Portland, OR (USA), 15-18 Aug 1989). Order Number DE89014263/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Flash radiography have determined the size and velocity vectors in the near field of fragments from tail- and side-initiated MK 82 MOD 1, general-purpose bombs. Excellent radiographs have been acquired from nine separate tests. Unlike arena tests, the radiographs were taken 75 to 125 cm from the case and show that the fragments peel off the case in long strips. A major concern in the design and execution of the experiments was the protection of the 450-kV x-ray heads and the film cassettes from fragments and blast produced by the 500-lb bombs. The velocity and size data, along with optical and electronic pin data, were used to characterize the fragments of the donor bomb in a donor-acceptor sympathetic detonation system study. The bombs were found to contain large shrink voids, randomly located from bomb to bomb, in the explosive Tritonal fill. Characteristics of the fragments from the void side if the bomb were found to be as much as 10% different from the nonvoid

side and were much less reproducible than the fragments characteristics of the nonvoid side. The data collected will be useful in evaluating sympathetic detonation mitigation systems designed for use with the bombs. Such mitigation systems may be required for mass storage methods to meet the evolving insensitive munition requirements. 13 refs., 7 figs.

38875 (OEFZS–4485) **Gammaspectrometric determination of copper in whole blood and urine.** Lazarova, M.; Michailov, M.; Teherani, D.K.; Kehrer, M.; Stehlik, G. Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (Austria). Jan 1989. 7p. (In German). (BL–792/89). Order Number DE89630765/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

A simple and rapid method for isolation of copper from whole blood and urine after complexing with pyrrolidindithiocarbonic acid (NH_4-salt) has been developed. The isolated copper was determined after neutron irradiation by using a pneumatic transfer system and measuring the induced activity of the short-lived radionuclid ^{66}Cu. 19 refs., 2 tabs.

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Refer also to citation(s) 37856, 37887, 37971, 38019, 38066, 38067, 38085, 38292, 39002, 39394

38876 (CONF-890830–1) **Ionization of acetic acid in NaCl(aq) media: A potentiometric study to 573K and 130 bars.** Mesmer, R.E.; Patterson, C.S.; Busey, R.H.; Holmes, H.F. Oak Ridge National Lab., TN (USA). 1989. 37p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From Calorimetry conference; Oak Ridge, TN (USA); 4 Aug 1989. Order Number DE89007831/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Ionization quotients of aqueous acetic acid have been precisely determined in NaCl(aq) media to 5 mol/kg from 50° to 300°C using a potentiometric cell previously developed at Oak Ridge National Laboratory. Pressure coefficients were also determined to 250°. Results have been combined with selected information in the literature and modeled using both the Pitzer ion-interaction treatment and a conventional ionic strength approach. Thermodynamic quantities for the ionization reaction have been derived including the equilibrium constant, activity coefficient quotients, and pressure coefficients, along with the changes in enthalpy, entropy, heat capacity, and volume for the reaction. 58 refs., 6 figs., 8 tabs.

38877 (CONF-890830–2) **Raman spectroscopy of aqueous phosphate solutions at temperatures up to 450°C: Two liquid phases, supercritical fluids, and pyro- to ortho-conversions.** Marshall, W.L.; Begun, G.M. Oak Ridge National Lab., TN (USA). 31 Mar 1989. 29p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From Calorimetry conference; Oak Ridge, TN (USA); 4 Aug 1989. Order Number DE89011227/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A new high temperature Raman furnace-cell assembly has been built and used to obtain Raman spectra of aqueous phosphate solutions at temperatures from 25 to 450°C. The solutions studied were of mono- and disodium orthophosphates and pyrophosphates, and of phosphoric acid. Rates of hydrolysis of the pyrophosphates to orthophosphates at temperatures between 100° and 250°C were observed. The Raman spectra of both the highly concentrated and dilute immiscible solutions, formed at temperatures above 275°C at particular compositions, and the Raman spectra of supercritical fluids containing the dissolved phosphate species were recorded. These observations confirm the strong stability of the orthophosphate species at the high temperature although weak pyrophosphate peaks appear in several cases. Concentrated second liquid phases show essentially the same orthophosphate species as those in the dilute liquid phase in equilibrium. The Raman spectra of water in these solutions show characteristics at 300–450°C very similar to those observed in the Raman study by Lindner of pure water. 32 refs., 12 figs.

38878 (INIS-mf–11440, pp. 142-143) **Isotopic effects I kinetic energy spectra of the deuterated pyridine.** Cuna, S. (Institutul de Tehnologie Izotopica si Moleculara, Cluj-Napoca (Romania)); Cuna, C. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics*. Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Partly deuterated pyridine, examining the kinetic energy spectra of the ions obtained into a double focusing mass spectrometer MAT-311 by MIKE and HV methods, was studied. (authors).

38879 (INIS-mf–11440, pp. 140-141) **Time of flight mass spectrometers.** Cuna, C. (Institutul de Tehnologie Izotopica si Moleculara, Cluj-Napoca (Romania)); Cuna, S. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics*. Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Different types of time of flight mass spectrometers are presented. (authors).

38880 (INIS-mf–11440, pp. 138-139) **Evaluation of the mechanical errors influence on the image deformation at double focusing mass spectrometers.** Cuna, C. (Institutul de Tehnologie Izotopica si Moleculara, Cluj-Napoca (Romania)). Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics*. Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Using matrix method it is possible to estimate the tolerances into processing and assembling of the double focusing mass spectrometers.

38881 (INIS-mf–11440, pp. 131-132) **Increased water isotopes analysis speed with mass spectrometer SMAD-2.** Berdea, F. (Institutul de Tehnologie Izotopica si Moleculara, Cluj-Napoca (Romania)); Cuna, C. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics*. Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

A new method in water isotopes analysis with mass spectrometer SMAD-2 is proposed. (authors).

38882 (LA-UR–89-1882) **Evaluation of atomic oxygen interaction with thin-film aluminum oxide.** Cross, J.B.; Lan, E.H.; Smith, C.A.; Arrowood, R.M. Los Alamos National Lab., NM (USA). 1989. 16p. Sponsored by DOE Management & Administration. DOE Contract W-7405-ENG-36. (CONF-890853–1: 3. international conference on surface modification technologies, Neuchatel (Switzerland), 28 Aug - 1 sep 1989). Order Number DE89014242/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Effects of atomic oxygen on thin-film (750Å) sputtered aluminum oxide (Al_2O_3) have been characterized. Experiments were conducted using the Los Alamos National Laboratory (LANL) O-atom facility. Diffusion of O-atoms through the Al_2O_3 thin films was observed, having an activation energy of 5.2 kcal/mole at an O-atom kinetic energy of 2 eV. Silver oxidation was used as the technique to detect penetration of O-atoms through thin-films. The Al_2O_3 films were deposited on silver (250Å), and the electrical resistance of the silver was measured in-situ during exposure. The thin films provided better protection of the substrate when deposited on smooth sapphire surfaces than when deposited on rougher alumina surfaces. The Al_2O_3 was amorphous before and after exposure, with less than 2% variation in oxygen atomic concentration and total Al_2O_3 thickness before and after exposure. 14 refs., 10 figs., 1 tab.

38883 (LBL–27164) **Oxidative addition of C–H bonds in organic molecules to transition metal centers.** Bergman, R.G. Lawrence Berkeley Lab., CA (USA). Apr 1989. 7p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-8904236–1: Annual chemical congress; 31. national organic symposium, Hull, UK; Ithaca, NY, USA, 4-7 Apr 1989; 18-22 jun 1989;CONF-8906152–1). Order Number DE89012991/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Alkanes are among the most chemically inert organic molecules. They are reactive toward a limited range of reagents, such as highly

energetic free radicals and strongly electrophilic and oxidizing species. This low reactivity is a consequence of the C–H bond energies in most saturated hydrocarbons. These values range from 90 to 98 kcal/mole for primary and secondary C–H bonds; in methane, the main constituent of natural gas, the C–H bond energy is 104 kcal/mole. This makes methane one of the most common but least reactive organic molecules in nature. This report briefly discusses the search for metal complexes capable of undergoing the C–H oxidative addition process allowing alkane chemistry to be more selective than that available using free radical reagents. 14 refs.

38884 (PNL-SA–16623) **Chemical bonding in phosphonitrilic systems—comparison of the electronic structures of $(F_2PN)_3$, $(F_2PN)_4$, and $OP(F_2)NP(F_2)NPF_3$.** Ferris, K.F.; Duke, C.B. Pacific Northwest Lab., Richland, WA (USA). May 1989. 17p. Sponsored by DOE Energy Research. DOE Contract AC06-76RL01830. (CONF-8904241–1: Sanibel Symposia, St. Augustine, FL, USA, 1-8 Apr 1989). Order Number DE89014460/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The electronic structure of phosphonitrilic systems contain both π' (in-plane) and π (out-of-plane) bonding systems. Earlier work in this laboratory has indicated that the d-orbital involvement in these systems affects primarily the electronic structure, and is modulated by ligand electronegativity. Ab initio molecular orbital calculations were performed on a series of small phosphazene molecules [$(F_2PN)_3$, $(F_2PN)_4$and $OP(F_2)NP(F_2)NPF_3$] to elucidate the electronic and molecular structure of these small molecules as models for polymeric systems. The chemical bonding and charge distribution in the phosphonitrilic trimers, tetramers and these small fragments is highly polarized, primarily through the π and π' bonding networks. Our results indicate that while the majority of the electronic aspects of $OP(F_2)NP(F_2)NPF_3$can be described by analogies to $(F_2PN)_3$ and $(F_2PN)_4$, major geometric differences such as bond alternation are evident. The opening of the P-N-P bond angles in the linear fragment results in reduced overlap over multiple centers, promoting "islands of delocalization" first proposed by Dewar et al. 18 refs., 3 figs., 3 tabs.

38885 **Fused salt reactions of organosulfur compounds.** Nowak, M.A. (Department of Energy, Pittsburgh, PA (USA)); Utz, B.R.; Fauth, D.J.; Friedman, S. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(4): 46-52 (1987). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA (USA), 30 Aug - 4 sep 1987).

The treatment of coal with molten caustic is an effective method for cleaning coal. Molten caustic treatment removes not only mineral matter but most of the sulfur, including organic sulfur, from coal. While the chemical processes leading to the removal of inorganic sulfur have been examined, the mechanics of organic sulfur removal is less understood. Coal characterization studies suggest that the organosulfur moieties in coal may be largely thiophene-type ring structures. A preliminary investigation in this laboratory studied the reaction of benzothiophene with sodium and potassium hydroxides. Evidence was obtained that o-thiocresolates were intermediates in the desulfurization reaction. The overall reaction is multistep; the ring opening is a key step, since only after conversion to a thio derivative does desulfurization take place. Our findings on the desulfurization of thiols and thiol derivatives will be discussed here.

38886 **Modeling the thermal reactions of benzyl phenyl sulfide.** Abraham, M.A. (Univ. of Delaware, Newark (USA)); Klein, M.T. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 189-201 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

The reactions of benzylphenylsulfide (BPS) neat, in benzene, in tetralin and with added thiophenol were studied. A free-radical mechanism described the neat pyrolysis of BPS to the major products toluene, thiophenol, diphenyldisulfide, and diphenylsulfide. An analytical rate expression deduced from this mechanism was consistent with results from both neat pyrolysis and reaction with additives. The secondary reactions of primary products were detailed.

38887 **Use of semigrand ensembles in chemical equilibrium calculations on complex organic systems.** Alberty, R. A. (Department of Chemistry, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139 (US)); Oppenheim, I. *Journal of Chemical Physics (USA),* 91(3): 1824-1828 (1 Aug 1989).

When chemical potentials of some reactants are externally fixed, the equilibrium pressures of other reactants can be calculated thermodynamically using Legendre transforms of the usual thermodynamic potentials and statistical mechanically using semigrand ensembles. The use of the semigrand isobaric partition function for complex organic systems involving chemical reactions is discussed. This partition function provides a simplified, but comprehensive, view of chemical equilibrium within homologous and related series, which involve infinite numbers of species. The transformed thermodynamic properties for equilibrium systems of this type are expressed in terms of the molecular partition functions of the various species.

38888 **Ni clusters: Structures and reactivity with D_2.** Raghavan, K. (Ames Laboratory USDOE and Department of Chemistry, Iowa State University, Ames, Iowa 50011 (US)); Stave, M. S.; DePristo, A. E. *Journal of Chemical Physics (USA),* 91(3): 1904-1917 (1 Aug 1989). DOE Contract W-7405-ENG-82.

We report the results from a theoretical investigation of the structures and reactivity of various isomers of Ni clusters in the size range from 4 to 13 atoms. The geometries of the clusters were optimized using binding energy values calculated by the corrected effective medium (CEM) theory. Two different potential energy surfaces were used to describe the interaction between D_2 and the Ni clusters. The first used the form and parameters that were determined in the study of H_2 dissociative chemisorption on Ni surfaces, while both used atomic positions appropriate to the clusters, the second used the same form but determined the parameters by comparison to CEM values of the H/Ni_{13} interaction. Using these PES, we investigated the dissociation dynamics of D_2 on Ni_N (N=4–13) clusters by classical trajectory techniques. We found that: (1) for clusters of size less than Ni_6 , the rate constants varied strongly with cluster size; and (2) for all size clusters, the rate constants were very sensitive to different isomers. This isomeric variation of the rate constant is discussed in terms of various structural features in different isomers, a number of which do not have any analogy in the dissociative chemisorption on low Miller index surfaces.

38889 **Collisional electron detachment and decomposition cross sections for SF^-_6, SF^-_5, and F^- on SF_6 and rare gas targets.** Wang, Y. (Department of Physics, College of William and Mary, Williamsburg, Virginia 23185(US)); Champion, R. L.; Doverspike, L. D.; Olthoff, J. K.; Van Brunt, R. J. *Journal of Chemical Physics (USA),* 91(4): 2254-2260 (15 Aug 1989).

Absolute total cross sections for collisional electron detachment and collision-induced dissociation (CID) have been measured for binary collisions of SF^-_6 and SF^-_5 with rare gas and SF_6 targets for laboratory collision energies ranging from about 10 up to 500 eV. The cross sections for electron detachment of SF^-_6 are found to be surprisingly small, especially for the SF_6 target, for relative collision energies below several tens of electron volts. Specifically, detachment onsets are found to occur at around 30 and 90 eV for the rare gas and SF_6 targets, respectively. The CID channel which leads to F^- as a product is observed to dominate detachment for relative collision energies below 100 eV. The results for the SF^-_5 projectile are remarkably similar to those exhibited for SF^-_6. The role of long-lived excited states in the reactant SF_6 ion beam is discussed. SF_6

38890 **Collisional electron detachment and decomposition rates of SF^-_6, SF^-_5, and F^- in SF_6: Implications for ion transport and electrical discharges.** Olthoff, J. K. (National Institute of Standards and Technology, Gaithersburg, Maryland 20899(US)); Van Brunt, R. J.; Wang, Y.; Champion, R. L.; Doverspike, L. D. *Journal of Chemical Physics (USA),* 91(4): 2261-2268 (15 Aug 1989).

Measured cross sections for prompt collisional detachment and decomposition of SF^-_6, SF^-_5, and F^- in SF_6 reported in the preceding companion paper are used to calculate detachment coefficients and ion-conversion reaction coefficients as functions of electric field-to-gas density ratio (E/N) for ion drift in SF_6. Analysis from a model presented here using these coefficients suggests that prompt electron detachment from SF^-_6 and SF^-_5 in SF_6 are insignificant processes in such ion-drift experiments. Calculated rates for ion-conversion processes indicate the necessity to: (1) reexamine the previously measured rates in SF_6 from drift-tube experiments, and (2) use ion kinetic-energy distributions with larger

high-energy tails than the standard distributions assumed in earlier calculations. The calculated detachment and reaction coefficients are used in a model which invokes detachment from long-lived energetically unstable states of collisionally excited SF^-_6 to explain the pressure dependence of previously measured detachment coefficients and the high detachment thresholds implied by analysis of electrical-breakdown probability data for SF_6. Consistent with the interpretation of results from earlier work, the model indicates that at high pressure, measured detachment coefficients depend primarily upon rates for ion conversion and prompt collisional detachment from F^-.

38891 Reactant states model: Predicted $k(E,J)$ for $NO_2(^2A_1)\rightarrow O(^3P)+NO(^2\Pi)$, based on spectroscopic data. Toselli, B. M. (Department of Atmospheric, Oceanic, and Space Sciences, Space Physics Research Laboratory, The University of Michigan, Ann Arbor, Michigan 48109-2143(US)); Barker, J. R. *Journal of Chemical Physics (USA),* 91(4): 2239-2253 (15 Aug 1989).

High-order spectroscopic data for the reactant are used *exclusively* to determine both the sum of open reactive channels and the density of states, which are used in a statistical theory to predict dissociation rate constants. Practical methods are introduced for calculating sums of reactive channels and densities of states, when *couplings among* {ll} *degrees of* reedom *are* included. An empirical method is described for reconciling spectroscopic parameters with known dissociation energies (also determined spectroscopically). The predicted $k(E,J)$'s and thermal $k_\infty(T)$ for NO_2 dissociation are in good agreement with experimental data, especially when the effects of electronically excited states are included. The predicted low pressure thermal rate constants are generally in fair agreement with experiment, although a slightly different temperature dependence is calculated; this discrepancy is probably due to the absence of unknown higher order spectroscopic terms and to the crude corrections made for excited electronic states. When high order spectroscopic (or theoretical) data are available and when the effects due to excited electronic states are considered, this theory is useful for predicting, fitting, and interpreting unimolecular rate data.

38892 Theoretical study of the C–H bond dissociation energy of acetylene. Curtiss, L. A. (Chemical Technology Division/Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439(US)); Pople, J. A. *Journal of Chemical Physics (USA),* 91(4): 2420-2423 (15 Aug 1989). DOE Contract W-31-109-ENG-38.

A systematic study of the energies of acetylene and ethynyl radical and cation using high levels of *ab initio* molecular orbital theory, including correlation effects beyond fourth order perturbation theory, is presented. The bond dissociation energy of acetylene D_0(HCC–H), is calculated to be 5.79 eV with an expected accuracy of ±0.1 eV. The $^3\Pi$ ground state of C_2H^+ is calculated to be 0.36 eV more stable than the $^3\Sigma-$ state. The ionization potential of ethynyl radical (C_2H) is calculated to be 11.65 eV.

38893 Potential energy surfaces for YH^+_2 and ZrH^+_2. Das, K. K. (Department of Chemistry, Arizona State University, Tempe, Arizona 85287-1604(US)); Balasubramanian, K. *Journal of Chemical Physics (USA),* 91(4): 2433-2442 (15 Aug 1989).

Electronic structures, potential energy surfaces, and one-electron properties of 16 electronic states of two transition metal dihydride ions YH^+_2 and ZrH^+_2 are calculated using the complete active space multiconfiguration self-consistent field (MCSCF) followed by a full second-order configuration interaction (SOCI) method. The MCSCF/SOCI method yields $^1A_1$ as the ground state for YH^+_2 with r_e=1.833 A and θ_e=116° and a $^2A_1$ ground state for ZrH^+_2 with r_e=1.75 A and θ_e=113.5°. The SOCI atomization energy [$YH^+_2(^1A_1)\rightarrow Y^+(^1S)+2H$] is calculated to be 5.22 eV in good agreement with an experimental value of 5.52 eV at 298 K for this process. The $D_e(Y^+–H)$ for YH^+ is calculated to be 58.9 kcal/mol in excellent agreement with an experimental value of 58±3 kcal/mol. The first adiabatic ionization potentials of YH_2 and ZrH_2 are calculated as 6.18 and 6.95 eV, respectively. The excited $Zr^+(^2D)$ ion inserts spontaneously into H_2 leading to the bent ground state of ZrH^+_2, while the ground state of Zr^+ does not insert into H_2. The $^1S_0$ ground state of Y^+ has to surmount a small barrier of about 10 kcal/mol for insertion into H_2. The addition of *f* type diffuse functions does not change the geometrical parameters much.

38894 Monte Carlo studies of hydrogen fluoride clusters: Cluster size distributions in hydrogen fluoride vapor. Zhang, C. (Department of Chemistry, The University of Rhode Island, Kingston, Rhode Island 02881-0801(US)); Freeman, D. L.; Doll, J. D. *Journal of Chemical Physics (USA),* 91(4): 2489-2497 (15 Aug 1989).

An investigation into the structure and composition of hydrogen fluoride vapor is reported. Calculations are performed using a modified central force model potential developed by Klein and McDonald. Using a simulated annealing procedure, minimum energy structures for HF clusters are investigated ranging in size from n=2 to 7. Good agreement is found for the structural parameters obtained from the model potential and other theoretical and experimental information. The Monte Carlo method is used to determine the thermodynamic energy, entropy, and Gibbs free energy of the hydrogen fluoride clusters at 1 atm pressure and 100 and 273 K. A minimum in the Gibbs free energy change is found at n=4 implying that tetramers are very important in the vapor.

38895 Laser studies of the reactivity of SiH with the surface of a depositing film. Ho, P. (Sandia National Laboratories, Albuquerque, New Mexico 87185-5800(US)); Breiland, W. G.; Buss, R. J. *Journal of Chemical Physics (USA),* 91(4): 2627-2634 (15 Aug 1989). DOE Contract AC04-76DP00789.

A new method for studying the interaction of radicals with the surface of a depositing film is presented. This method combines spatially resolved laser spectroscopy with molecular beam techniques and is demonstrated by measuring the state-resolved reactivity of SiH molecules with the surface of a depositing amorphous hydrogenated silicon film. SiH molecules from a silane glow discharge react at the surface with greater than 0.94 probability. The spatial distribution of the desorbing SiH is consistent with a cosine angular distribution. No dependence of reactivity on rotational state of the SiH was observed.

38896 A new technique for the determination of surface adsorbate geometries utilizing second harmonic generation and absorption band shifts. Peterson, E. S. (Department of Chemistry, University of California at Berkeley, Berkeley, California 94720 and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720(US)); Harris, C. B. *Journal of Chemical Physics (USA),* 91(4): 2683-2688 (15 Aug 1989). DOE Contract AC03-76SF00098.

A combination of second harmonic generation (SHG) and a simple dipole–dipole interaction model is presented as a new technique for determining adsorbate geometries on surfaces. The polarization dependence of SHG is used to define possible geometries of the adsorbate about the surface normal. General formulas for absorption band shifts using the geometry constraints imposed by the SHG data are derived for a dimer constructed from two arbitrarily placed monomers on the surface using the dipole–dipole interaction potential. These formulas can be used to determine the orientation of the two monomers relative to each other. A simplified version of this formalism is used to interpret absorption band shifts for a system of rhodamine *B* adsorbed on quartz.

38897 Observation of internal rotation in the $NH^+_4(NH_3)_4$ ionic cluster. Price, J. M. (Department of Chemistry, University of California, Berkeley, California 94720 and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, 1 Cyclotron Road, Berkeley, California 94720(US)); Crofton, M. W.; Lee, Y. T. *Journal of Chemical Physics (USA),* 91(4): 2749-2751 (15 Aug 1989). DOE Contract AC03-76SF00098.

The infrared vibrational predissociation spectrum for the title ionic cluster is presented. The interesting feature observed in the spectrum is the presence of rotation–vibration transitions due to the nearly free internal rotation of the solvent ammonia molecules attached to the ammonium ion core. Internal rotation within an ionic cluster has never been observed before.(AIP)

38898 Process for the preparation of benozotriazoles and their polymers, and 2(2-hydroxy-5-isopropenylphenyl)2H-benzotriazole produced thereby. Vogl, O.; Nir, Z. To Dept. of Energy, Washington, DC. USA Patent 4,812,575. 14 Mar 1989. Filed date 29 Sep 1983. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

The compound 2(2-hydroxy-5-isopropenylphenyl)2H-benzotriazole (2H5P) is produced by azo coupling of o-nitrophenyl diazonium chloride with p-hydroxyacetophenone, subjecting the resulting isolated azo compound to reductive cyclization with zinc in the presence of sodium hydroxide at a temperature of about 50^0-70^0C., acidifying the resulting mixture so as to produce 2(2-hydroxy-5-acetylphenyl)2H-benzotriazole (2H5A), acetylating the isolated 2(2-hydroxy-5-acetylphenyl)2H-benzotriazole (2H5A), so as to produce 2(2-acetoxy-5-acetylphenyl)2H-benzotriazole (2A5A), methylating the isolated 2(2-acetoxy-5-acetylphenyl)2H-benzotriazole (2A5A) with a methyl Grignard reagent and dehydrating the isolated reaction product with potassium hydrogen sulfate so as to produce 2(2-hydroxy-5-isopropenylphenyl)2H-benzotriale (2H5P). The compound is used as a polymerizable ultraviolet light stabilizer.

4004 Electrochemistry

Refer also to citation(s) 38770, 38818

4005 Photochemistry

Refer also to citation(s) 37882, 38821

38899 (LBL–24018, pp. 3-5) **Chemistry of electronically excited molecules.** Pimentel, G.C. Lawrence Berkeley Lab., CA (USA). Sep 1987. In *Chemical Biodynamics Division: Annual report, October 1, 1986-September 30, 1987.* Order Number DE88004886/JAW. Available from NTIS, PC A04/MF A01.

This research is directed toward fundamental understanding of the special chemistry of electronically excited molecules, which is involved in every photosynthetic photon energy storage process. An electronically excited molecule differs from the ground state in orbital occupancy, charge distribution, molecular structure, and chemical reactivities. These differences are the key to photon energy storage. Infrared spectroscopy coupled with matrix isolation provides a powerful diagnostic technique. Absorption features are sharp and informative about molecular structures. With a tunable laser photolysis source, we are attempting to map electronic hypersurfaces. Both unimolecular (photochromic) and bimolecular reactions are under study. To increase our knowledge of matrix-induced surface crossing, we are investigating fluorescence and phosphorescence as well.

38900 (LBL–24018, pp. 5-8) **Photon conversion through storage of metastable molecules.** Frei, H. Lawrence Berkeley Lab., CA (USA). Sep 1987. In *Chemical Biodynamics Division: Annual report, October 1, 1986-September 30, 1987.* Order Number DE88004886/JAW. Available from NTIS, PC A04/MF A01.

The purpose of this program is to search for and evaluate chemical systems which permit use and storage of near infrared photons, and allow to accomplish their efficient conversion into useful energy. The importance for exploring chemistry with these long wavelength quanta derives from the fact that photochemical reactions which can be initiated by these photons are very sparse despite the fact that more than half of the solar irradiance at ground level lies in the near infrared (wavelengths longer than 700 nm). Our work is aimed at contributing to this key problem in solar photochemistry in two ways. First, on a fundamental level, we are searching for low energy paths of bimolecular reactions that would allow us to initiate the chemistry with near infrared photons. Secondly, on a level directly aiming at photon storage and conversion, we are studying chemical systems which permit synthesis with near infrared photons, accomplish their storage, and offer a way for efficient conversion of the stored chemical energy into useful energy.

38901 (LBL–24018, pp. 8-10) **Artificial photosynthesis.** Calvin, M.; Otvos, J.W. Lawrence Berkeley Lab., CA (USA). Sep 1987. In *Chemical Biodynamics Division: Annual report, October 1, 1986-September 30, 1987.* Order Number DE88004886/JAW. Available from NTIS, PC A04/MF A01.

The long term ultimate solution of our needs for liquid fuels from renewable sources will be the construction of synthetic systems which will enable us to convert solar energy directly into useful chemical species, both as chemicals and for fuels. We are using what we know about the natural process of photosynthesis, insofar as it involves quantum conversion into stable chemical products, to guide us in the design of these totally synthetic systems. The principal factor which enables green plants to convert incoming visible quanta into some stable chemical form long enough to do secondary chemical reactions for storage involves the separation of charge across a phase boundary. The positive charge (hole) is ultimately used to generate oxygen from water and the negative charge is used to reduce carbon dioxide. The phase boundaries under study are: (1) the lipid bilayer walls of phospholipid vesicles which are used to keep separate the initial photoproducts; (2) the surfaces of various polyelectrolytes; and (3) the surfaces of various colloids.

4006 Radiation Chemistry

Refer also to citation(s) 39289

4007 Radiochemistry and Nuclear Chemistry

38902 (INIS-mf–11459, pp. 33) **^{99m}Tc-Sn-hydroxyethyliden disodium phosphonate synthesis and labelling.** Chacon, E. (Instituto Peruano de Energia Nuclear, Lima (Peru)); Cruz, C.; Caballero, J.; Quezada, J. Sociedad Quimica del Peru, Lima (Peru). Oct 1987. (In Spanish). (CONF-8710479–: 15. Peruvian Congress of Chemistry, Lima (Peru), 12-17 Oct 1987). In *Resumenes de los trabajos.* Order Number DE89012192/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

PHOSPHONATES/labelled compounds; TECHNETIUM 99/labelled compounds; HYDROXY COMPOUNDS; PHOSPHONATES; SODIUM COMPOUNDS; TECHNETIUM COMPOUNDS; TIN

38903 (INIS-mf–11471, pp. 1) **Role of radiochemical analysis 50 years after the discovery of nuclear fission.** Niese, S. (Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic)). Chemische Gesellschaft der DDR, Berlin (German Democratic Republic); Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic). 1988. (In German). (CONF-8811239–: Colloquium on on separation processes in radiochemical practice, Dresden, German Democratic Republic, 8 Nov 1988). In *Abstracts of the colloquium 'separation processes in radiochemical practice'.* Order Number DE89630813/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

RADIOMETRIC ANALYSIS/separation processes; FISSION PRODUCTS; METEORITES; MULTI-ELEMENT ANALYSIS; MULTI-ELEMENT SEPARATION; PRECIPITATION; RADIOISOTOPES; THORIUM ISOTOPES; URANIUM ISOTOPES

38904 (INIS-mf–11471, pp. 2) **Fission product ^{89}Sr is well suited for medical therapy.** Wagner, G. (Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic)); Jantsch, K. Chemische Gesellschaft der DDR, Berlin (German Democratic Republic); Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic). 1988. (In German). (CONF-8811239–: Colloquium on on separation processes in radiochemical practice, Dresden, German Democratic Republic, 8 Nov 1988). In *Abstracts of the colloquium 'separation processes in radiochemical practice'.* Order Number DE89630813/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

STRONTIUM 89/ion exchange; STRONTIUM 89/radiotherapy; BUTYRIC ACID; CATIONS; FISSION PRODUCTS; IMPURITIES; KETO ACIDS; PURIFICATION; SEPARATION PROCESSES; STRONTIUM CHLORIDES; RADIOTHERAPY; STRONTIUM 90; URANIUM ISOTOPES

38905 (INIS-mf–11471, pp. 5) **Generation of activity with and release of activity from gas targets.** Steinbach, J. (Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic)). Chemische Gesellschaft der DDR, Berlin (German Democratic Republic); Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic). 1988. (In German). (CONF-8811239–: Colloquium on on separation processes in radiochemical practice, Dresden, German Democratic Republic, 8 Nov 1988). In *Abstracts of the colloquium 'separation processes in radiochemical practice'.* Order Number DE89630813/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

ISOTOPE PRODUCTION/targets; TARGETS/bismuth oxides; CARBON 11; FLUORINE 18; IODINE 123; TARGETS; NITROGEN 13; OXYGEN 15; POSITRON COMPUTED TOMOGRAPHY; RADIOPHARMACEUTICALS; RUBIDIUM 81

38906 (INIS-mf–11471, pp. 6) **Chemical and nuclear engineering requirements on a separation plant in nuclear engineering.** Boessert, W. (Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic)); Bernhard, G.; Hladik, O. Chemische Gesellschaft der DDR, Berlin (German Democratic Republic); Zentralinstitut fuer Kernforschung, Rossendorf (German Democratic Republic). 1988. (In German). (CONF-8811239–: Colloquium on on separation processes in radiochemical practice, Dresden, German Democratic Republic, 8 Nov 1988). In *Abstracts of the colloquium 'separation processes in radiochemical practice'.* Order Number DE89630813/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

MOLYBDENUM 99/ion exchange; NUCLEAR ENGINEERING/separation processes; ALUMINIUM OXIDES; ENGINEERING; ISOTOPE PRODUCTION; RADIOCHEMISTRY; ZFK ROSSENDORF

38907 (INIS-mf–11480, pp. 33) **Mass transfer in permeation columns.** Mueller, H.; Wachter, R. Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik. Nov 1988. (In German). In *Annual report of the Institute for Theoretical Physics in Graz, Austria.* Order Number DE89631627/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

EXTRACTION COLUMNS/mass transfer; LIQUIDS; PROGRESS REPORT; TECHNETIUM; TRACER TECHNIQUES

38908 (LBL–25588) **An introduction to the National Tritium Labeling Facility.** Dorsky, A.M.; Morimoto, H.; Saljoughian, M.; Williams, P.G.; Rapoport, H. Lawrence Berkeley Lab., CA (USA). Jun 1988. 4p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-880787–7: 3. international symposium on the synthesis and applications of isotopically labeled compounds, Innsbruck, Austria, 17-21 Jul 1988). Order Number DE89014906/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The facilities and projects of the National Tritium Labeling Facility are described. 5 refs., 1 fig., 1 tab.

4008 Combustion, Pyrolysis, and High-temperature Chemistry

Refer also to citation(s) 37839, 37884, 38942

38909 Oxidation/pyrolysis chemistry as related to fuel scooting tendencies. Brezinsky, K. (Princeton Univ., NJ (USA)); Glassman, I. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 394-405 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

The relationships between flame studies of the sooting tendencies of various hydrocarbon fuels and chemical mechanisms derived from flow reactor experiments have been developed. The mechanisms for the oxidation of benzene and butadiene, in particular, have been related to both sooting premixed and diffusion flames despite the large difference in basic flame structure. A recently developed soot formation mechanism has provided the linking framework between chemical mechanism and observable sooting tendencies. The same framework has permitted the application of flow reactor based chemical models to the prediction and explanation of the effect of oxygen addition on sooting diffusion flames.

38910 Kinetic mechanism for pyrolysis of acetylene near 1000K. Colket, M.B. III (United Technologies Research Center, East Hartford, CT (USA)). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 417-427 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

Recently a mechanism for acetylene pyrolysis was proposed to describe experimental data obtained from a single-pulse shock tube over the temperature range of 1100 to 2000K. The kinetic mechanism is similar to those proposed previously and includes mechanisms to describe formation of vinylacetylene, benzene, and phenylacetylene. Subsequently, a subset of this mechanism was modified and used to match decay profiles of acetylene as well as product formation for pyrolysis data obtained in a flow reactor at temperatures of 873 to 1173K. It is the objective of this study: (a) to extend the mechanism to include formation of higher molecular weight species, with a detailed discussion of growth from one to two rings; (b) to discuss the possible role of the odd radical, i-C_4H_3; (c) to discuss some uncertainties with modeling PAH formation.

38911 Mechanistic investigation of soot precursors. Bauer, S.H. (Cornell Univ., Ithaca, NY (USA)); Jeffers, P.M. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 428-439 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

Fuels with low H/C ratios are particularly prone to soot production during combustion; aromatic species generally (but not universally) do so more readily than aliphatics. It is now well recognized that soot is not a singular material. Besides characterizing the variety of soots with respect to composition, volatile content, and structure, extensive efforts have been devoted to determining conditions which promote the development of soot in flames and in internal combustion engines. In this report our objectives are: A. To call attention to the differences and the conceptual similarities between the sooting process and a kinetic model for nucleation/condensation. B. List the types of precursors required for sooting, and the underlying experimental basis. C. Present a minimal set of reactions, with rate constants, which model the observed time evolution of condensed molecular structures (soot precursors). This list must incorporate a repetitive growth cycle for continued condensation. As a minimum, the model must semiquantitatively reproduce observed delay times for the onset of condensation. D. Present qualitative spectral data which support C.

38912 Combustion tube soot from a diesel fuel/air mixture. Ebert, L.B. (Exxon Research and Engineering, Annandale, NJ (USA)); Scanlon, J.C.; Clausen, C.A. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 440-447 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

Used by the Chinese to make inks many years before Christ, soot was an environmental nuisance by the time of the industrial revolution. Today, soot can be both useful (the carbon black industry) and detrimental (diesel exhaust), so that investigation of soot can impact wide-ranging area. Curiously, although there is intuitive understanding about the commonality of soots from a variety of sources, including furnace flames, piston engines, combustion chambers, or premixed flames, there is no general agreement about the detailed molecular structure of soot. Recently, Zhang, O'Brien, Heath, Liu, Curl, Kroto, and Smalley (ZOHLCKS) proposed to interrelate soot with carbon clusters of icosahedral symmetry. They suggested that the polycyclic aromatic molecules known to be present in high concentrations in sooting flames may therefore adopt pentagonal rings as they grow, so as to generate spheroidal structures which maximize the number of C-C linkages, ultimately yielding a soot nucleus consisting of concentric, but slightly imperfect spheres. Thus, ZOHLCKS proposed that the spherical morphology of soot particles arose from soot molecules of nearly spherical symmetry. In this paper, we discuss the structural and chemical characterization of soot formed in a combustion tube, in part to address the ZOHLCKS proposal, in part to develop information to compare soot to a variety of other carbonaceous materials.

38913 Single pulse shock tube studies on the stability of 1-phenylbutene-2. Cui, J.P. (National Bureau of Standards, Gaithersburg, MD (USA)); He, Y.Z.; Tsang, W. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 448-455 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

1-Phenylbutene-2(1-PHB-2) has been decomposed in single pulse shock tube experiments. Acetylene formation is used as a measure of the rate of cleavage of the benzyl-vinyl C-C bond. The rate expression for this reaction has been found to be k(1-PHB-2 -> benzyl + propenyl)= 2.4 x 10^{16} Exp(-43780/T) /s. The A-factor for this process is unexpectedly large. It may be indicative of a larger

than usual combination rate constant for vinyl radicals. Possible sources of experimental errors are considered. Our results are consistent with a bond dissociation energy for the primary vinyl C-H bond in propylene of 475±10 kJ/mol.

38914 Shock-tube and modeling study of soot formation in mixtures of hydrocarbons. Frenklach, M. (Pennsylvania State Univ., University Park (USA)); Yuan, T.; Ramachandra, M.K. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 467-473 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

Interest in soot formation in binary hydrocarbon mixtures has increased in recent years. Besides the very practical aspects of such knowledge, the subject is of interest from a fundamental point of view: to provide additional information for the elucidation of the soot formation mechanism. There is evidence, both experimental and theoretical, that the key chemical reactions leading to soot formation in hydrocarbon systems are those between aliphatic and aromatic species. The importance of such reactions was suggested as early as 1960 by Stehling et al. This paper presents the results of a shock-tube pyrolysis study on soot formation from a series of binary hydrocarbon mixtures: benzene-additive, where the additives were acetylene, allene, vinylacetylene and 1,3-butadiene; and allene-acetylene, butadiene-acetylene and acetylene-hydrogen.

38915 Prediction of kinetics for C_4 species which form benzene. Westmoreland, P.R. (Univ. of Massachusetts, Amherst (USA)). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 480-487 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

Rates are predicted and compared here for the reactions that form and destroy 1-C_4H_3, 1-C_4H_5, and other C_4H_3 and C_4H_5 isomers. Rate constants are estimated by analogy and thermochemical kinetics for H-abstraction from 3-butenyne (C_4H_4 or vinylacetylene) and from 1,3-C_4H_6. Using Bimolecular Quantum-RRK, rate constants, branching and pressure dependence are predicted for the association reactions of radical addition ($C_2H+C_2H_2$ and $C_2H_3+C_2H_2$), H-addition (to C_4H_2 and C_4H_4), and H/radical and radical/radical recombination (H+C_4 radicals, $C_2H+C_2H_3$ and $C_2H_3+C_2H_3$).

38916 Formation of small aromatic molecules in a sooting ethylene flame. Harris, S.J. (General Motors Research Laboratories, Warren, MI (USA)); Weiner, A.M.; Blint, R.J. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 488-504 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

Small aromatic species are undoubtedly important precursor molecules in the formation of polycyclic aromatic hydrocarbons and soot, two important pollutants in diesel, direct-injection stratified charge (DISC), and other heterogeneous-combustion engines. Unfortunately, the chemical route to their formation is poorly understood, in part because rate constants for reactions of aromatic species at flame temperatures are largely unknown. In this work we used a quartz sampling probe to measure the concentration profiles of the single-ring aromatics benzene, phenylacetylene, and styrene in a heavily sooting premixed ethylene flame. A detailed chemical kinetics model was then constructed for the purpose of explaining the flame chemistry. The model, which uses estimated rate constants for many of the reactions involving aromatic species, gives good predictions for benzene and styrene and fair predictions for phenylacetylene. A sensitivity analysis has isolated a particular chemical reaction which controls their rate of formation, and it shows that even large errors in the other aromatic rate constants have relatively little effect on the predictions. Our approach will be applied in the future to trying to understand the formation of larger aromatic species and soot.

38917 Soot formation in hydrocarbon diffusion flames. Miller, J.H. (George Washington Univ., DC (USA)); Hamins, A.; Kohout, T.A.; Smyth, K.C.; Mallard, W.G. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 505-512 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

In our laboratory, specific attention has been given to identifying the important chemistry leading to the formation of the key precursor molecules to soot particle formation in diffusion flames. To achieve this goal measurements of the important intermediate gas phase species, temperature, and velocity fields have been required. The results of these studies provide a comprehensive data based with which to examine the phenomenon of soot particle inception in flames. In this paper, a review of some of the results of these studies will be given along with a discussion of area of future interest.

38918 Soot particle formation in diffusion flames. Santoro, R.J. (Pennsylvania State Univ., University Park (USA)). *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 513-523 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

The experiments to be described here are an extension of our previous laminar diffusion flame studies of soot particle formation. Specifically a detailed examination of the effect of fuel chemical structure has been undertaken. In our previous work, the emphasis has been on examining the effects of fuel flow rate and temperature on the production of soot in diffusion flames. In addition, specific attention was given to the processes controlling the emission of soot particles from the flame. These results along with the findings of other researchers has established the complex, coupled nature of the processes determining the soot particle evolution in the flame. The individual effects of temperature, flow field (e.g., velocity), pressure and fuel constitutents all must be investigated if a comprehensive understanding of the soot formation process is to be achieved.

38919 Are ions important in soot formation?. Calcote, H.F. (AeroChem Research Laboratories, Inc., Princeton, NJ (USA)); Olson, D.B.; Keil, D.G. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 524-533 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

Many chemical mechanisms have been proposed for the formation of incipient soot in flames. The ionic mechanism has not been widely embraced; it is considered a competitor to free radical mechanisms which have received more attention. In the ionic soot formation mechanism, the precursor ion reacts with neutral species, e.g., acetylenes, to produce larger ions. These larger ions continue to react further to produce ever increasingly larger ions. In this paper we review the evidence for the sequence of reactions starting with C_3H_{3+} and proceeding through large soot ions.

38920 Cluster size distribution for free molecular agglomeration. Mulholland, G.W. (National Bureau of Standards, Gaithersburg, MD (USA)); Samson, R.J.; Mountain, R.D.; Ernst, M.H. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 534-543 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

Dobbins and Megaridis have observed soot agglomerates in a diffusion flame via thermophoretic sampling. The agglomerates are made up of spherules with a typical diameter of about 30 nm. A characteristic of the agglomerate is the relatively low density of the structure with much open space. This study is concerned with modeling the agglomeration growth process.

38921 Simple method for predicting sooting tendencies of hydrocarbon fuels in premixed flames. Stournas, S. (National Technical Univ., Athens, GA (USA)); Lois, E. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 544-550 (1988). (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

One of the accepted measures of sooting tendencies of hydrocarbon fuels in premixed flames is the threshold fuel/oxidizer ratio, φ, which assumes combustion to CO_2 and H_2O. In this analysis it has been found that this sooting can be accurately predicted by using the group additivity approach based on the nature of the individual carbon atoms that exist in the fuel molecule. The only parameters needed for this prediction are the numbers of sp^3, sp^2, sp, aromatic and benzylic carbons along with the total number of hydrogen

atoms in the molecule. This approach has been used for the calculation of the sooting tendencies of 73 fuels whose measured φ has been reported in the literature. Even though the structure of these fuels varied widely and included alkanes, olefins, alkynes and aromatics, the calculated values were always very close to the measured ones. In fact, in 88% of the cases the predicted values lie within 5% of the measured ones, whereas the deviation in the rest never exceeds 10%.

38922 Oxidation kinetics of carbon blacks over 1300-1700 K. Felder, W. (AeroChem Research Laboratories, Inc., Princeton, NJ (USA)); Madronich, S.; Olson, D.B. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 551-558 (1988). (CONF-870802--: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

The oxidation of carbonaceous particulate matter is of wide practical concern in power generation and pollution reduction. Typically, in fuel-rich portions of combustion flames, OH radicals can be the major oxidizing species. However, in regions of combustors and in the exhaust where soot is present and OH concentrations are essentially negligible (regions in which particles spend the major portion of their lifetimes within a device), oxidation by excess oxygen is important. The work described here utilized an entrained flow reactor (a modified High Temperature Fast Flow Reactor, HTFFR) to determine the reactivity of two carbon blacks with O_2 in the 1300-1700 K range. A wide range of oxygen concentration was investigated while maintaining independent control of total pressure and flow velocity (particle residence time). A method and apparatus were developed for feeding particles to the HTFFR and assuring that particle sized lie below specified limits.

38923 Theoretical characterization of the potential energy surface for $H+O_2 \rightarrow HO^*_2 \rightarrow HO+O$. II. The potential for H atom exchange in HO_2. Walch, S. P. (ELORET Institute, Sunnyvale, California 94087(US)); Rohlfing, C. M. *Journal of Chemical Physics (USA),* 91(4): 2373-2375 (15 Aug 1989).

The results of CASSCF/multireference contracted CI calculations with large ANO basis sets are presented for the exchange region of the HO_2 potential energy surface. The saddle point for H atom exchange is $\approx$13 kcal/mol below the energy of $H+O_2$; therefore, this region of the surface will be accessible during $H+O_2$ recombination and metathesis reactions.

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Refer also to citation(s) 38099, 38178, 38187, 38190, 38205, 38349, 38376, 38410, 38433, 38440, 38804, 39094, 39105, 39754, 39770

38924 (BNL-NUREG-42675) **Relay testing parametric investigation of seismic fragility.** Bandyopadhyay, K.; Hofmayer, C.; Kassir, M.; Pepper, S. Brookhaven National Lab., Upton, NY (USA). [1989]. 7p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC02-76CH00016. (CONF-890855--41: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA, USA, 14-18 Aug 1989). Order Number DE89012669/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The seismic capacity of most electrical equipment is governed by malfunction of relays. An evaluation of the existing relay test data base at Brookhaven National Laboratory (BNL) has indicated that the seismic fragility of a relay may depend on various parameters related to the design or the input motion. In particular, the electrical mode, contact state, adjustment, chatter duration acceptance limit, and the frequency and the direction of the vibration input have been considered to influence the relay fragility level. For a particular relay type, the dynamics of its moving parts depends on the exact model number and vintage and hence, these parameters may also influence the fragility level. In order to investigate the effect of most of these parameters on the seismic fragility level, BNL has conducted a relay test program. The testing has been performed at Wyle Laboratories. Establishing the correlation between the single frequency fragility test input and the corresponding multifrequency response spectrum (TRS) is also an objective of this test program. This paper discusses the methodology used for testing and presents a brief summary of important test results. 1 ref., 10 figs.

38925 (CONF-890855--14) **Approximate solutions for dynamic plastic deformation of a tube.** Youngdahl, C.K. Argonne National Lab., IL (USA). 1989. 11p. Sponsored by DOE Energy Research. DOE Contract W-31109-ENG-38. From 10. international conference on Structural Mechanics in Reactor Technology (SMIRT); Anaheim, CA, USA; 14-18 Aug 1989. Order Number DE89009783/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The problem of determining the dynamic plastic deformation of a long, thin-walled tube or shell caused by a deliberate or accidental energy release over a small section of its interior has many practical applications. Because details of the energy release and the resulting time-dependent internal pressure distributions are not well known in most situations, parameter studies must be used to bound or approximate the distortion of the tube. Consequently, there is a need to develop methods for correlating the permanent deformation of the tube to simple parameters of the loading, without resorting to detailed solutions for numerous particular cases. This paper treats the problem of a long tube loaded by a time-dependent pressure distribution P(z,t) which is applied over a time-dependent region 2L(t). The plastic deformation is a combination of localized circumferential stretching and axial bending of the tube wall, which depend on the history of the applied force F(t) and the applied moment G(t) about z = 0 associated with the pressure distribution. The final plastic deformation depends on an effective applied force F_e, an effective applied moment G_e, an effective length of the loaded region $2L_e$, and the deformation which would be attained if the loading were applied as a pure impulse. All the effective values involve only simple integrals of the loading. Consequently, they do not depend on details of the loading functions and eliminate the need for obtaining time-dependent solutions for the deformation. 3 refs., 6 figs.

38926 (CONF-890855--35) **Impact analysis of shipping casks.** Pfeiffer, P.A.; Kennedy, J.M. Argonne National Lab., IL (USA). 1989. 7p. Sponsored by DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From 10. international conference on Structural Mechanics in Reactor Technology (SMIRT); Anaheim, CA (USA); 14-18 Aug 1989. Order Number DE89012423/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Shipping casks are being used in the United States Department of Energy to transport irradiated experiments, reactor fuel, radioactive waste, etc. One of the critical requirements in shipping cask analysis is the necessity to withstand severe impact environments. It is still conventional to develop the design and to verify the design requirements by hand calculations. Full three dimensional computations of impact scenarios have been performed but they are too expensive and time consuming for design purposes. Typically, on the order of more than an hour of CRAY time is required for a detailed, three dimensional analysis. The paper describes how simpler two- and three-dimensional models can be used to provide an intermediate level of detail between full three dimensional finite element calculations and hand calculations. The regulation that is examined here is: 10 CFR-71.73 hypothetical accident conditions, free drop. Free drop for an accident condition of a Class I package (approximate weight of 22,000 lb) is defined as a 30 foot drop onto a flat, essentially unyielding, horizontal surface, striking the surface in a position for which maximum damage is expected. Three free drop scenarios are analyzed to assess the integrity of the cask when subjected to large bending and axial stresses. These three drop scenarios are: (1) a thirty foot axial drop on either end, (2) a thirty foot oblique angle drop with the cask having several different orientations from the vertical with impact on the top end cask corner, and (3) a thirty foot side drop with simultaneous impact on the strength of the various components that comprise the cask. The predicted levels of deformation and stresses in the cask will be used to assess the potential damage level. 5 refs., 5 figs., 1 tab.

38927 (DOE/CE/15384--T4) **Textured substrate method for the direct continuous casting of steel sheet: Technical progress report No.4.** Gaspar, T. Ribbon Technology Corp., Gahanna, OH (USA). 14 Jul 1989. 7p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG01-88CE15384.

Order Number DE89015481/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The overall objective of this research project will be to demonstrate the feasibility of casting rapidly solidified steel strip 2 mm (0.080 in.) thick or greater using a textured chill block as described in US Patent No. 4,705,095, issues on November 10, 1987, to Ribbon Technology Corporation. The effect of melt overflow process variables on strip dimensions and uniformity will be investigated. Process variables include, but are not limited to, the following: super heat of the melt; wetting of substrate material; tundish design; and casting speed. Type 304 stainless and AISI 1020 standard carbon steel will be investigated.

38928 (GA-A–19419) **Analysis of the non-cylindrical GA-4 and GA-9 spent fuel casks.** Osborne, D.M.; Koploy, M.A.; Pickering, J.L. General Atomics, San Diego, CA (USA). Jun 1989. 11p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC07-88ID12698. (CONF-890631–55: International symposium on packaging and transporting of radioactive materials, Washington, DC, USA, 11-16 Jun 1989). Order Number DE89014249/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

DOE's Office of Civilian Radioactive Waste Management (OCRWM) has awarded General Atomics (GA) a contract to develop the GA-4 and GA-9 legal weight truck (LWT) transportation system to transport pressurized-water-reactor (PWR) and boiling-water-reactor (BWR) spent fuels. The GA-4 and GA-9 Casks maximize cargo capacity while complying with the weight limits imposed on legal weight truck transport. These casks will carry up to 4 PWR or 9 BWR spent fuel assemblies, a capacity four times greater than comparable existing designs. The approach to the structural analysis of a non-cylindrical cross-section differs from a cylindrical design. These differences include: More orientations are evaluated for impact analyses; the structural analyses are more complex; and applicable criteria are more conservative and some require additional development. GA's structural analyses of the GA-4 and GA-9 Casks address each of these analytical differences, resulting in casks that meet the criteria imposed by applicable regulatory guides and the ASME Code. When necessary, we have confirmed our analytical approach with component testing. GA will obtain further confirmation during model testing in 1990. 2 refs., 7 figs.

38929 (GA-A–19420) **Implementation of ANSI/ASME NQA-1 for development of GA-4 and GA-9 spent fuel casks.** Dunlap, M.G. General Atomics, San Diego, CA (USA). Jun 1989. 10p. Sponsored by DOE Radioactive Waste Management. DOE Contract AC07-88ID12698. (CONF-890631–56: International symposium on packaging and transporting of radioactive materials, Washington, DC, USA, 11-16 Jun 1989). Order Number DE89014248/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Department of Energy (DOE) Office of Civilian Radioactive Waste Management (OCRWM) has awarded General Atomics (GA) a contract to develop a legal weight truck (LWT) transportation system to transport boiling-water-reactor (BWR) and pressurized water reactor (PWR) spent fuels. DOE's contract requires GA to establish, maintain, and implement an NRC-approved Quality Assurance Program in accordance with ANSI/ASME NQA-1, "Quality Assurance Program Requirements" 1986 Edition (basic requirements and supplements), and the 1986 la Addenda. GA's Quality Assurance Program is a company-wide system described in GA's Quality Assurance Manual (QAM). General Atomics' Quality Assurance Program is implemented for a specific project by means of a Quality Assurance Program Document (QAPD). The QAPD is the document used by GA to invoke and document selected quality and project-applicable requirements. The QAPD is a tailored technical quality plan for a specific contract which can add to, revise, or delete certain portions of the basic GA QA Manual. The QAPD then becomes the controlling QA document for a specific project, and the provisions of the QAPD are followed by all project team members as though it were the QA Manual. For the legal weight truck (LWT) transportation project, GA has developed a QAPD that invokes the NRC-approved QA Program and also addresses the additional requirements that are included in the NQA-1 1986 Edition and la Addenda and the additional DOE/ID imposed requirements. 8 refs., 1 fig., 1 tab.

38930 (GEH–26434-100) **Catalog of Hanford buildings and facilities, 100 areas.** Battelle Pacific Northwest Lab., Richland, WA (USA). Apr 1964. 205p. Sponsored by DOE Nuclear Energy. DOE Contract AC06-76RL01830. Order Number DE89014969/JAW. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

The facilities, primarily buildings, are listed according to number but are also indexed alphabetically under name. A brief description is given which includes dimensions, essential and special features, and appurtenances. If utilities and services in the building are not described or qualified it should be assumed that they are typical of those expected for the type of building described. Simple line drawings and pictures are used to exemplify typical facilities and an indication of current usage is included for most of the buildings.

38931 (GEH–26434-300) **Catalog of Hanford buildings and facilities: 300 area.** General Electric Co., Richland, WA (USA). Hanford Atomic Products Operation. Apr 1964. 96p. Sponsored by DOE Nuclear Energy. DOE Contract AC06-76RL01830. Order Number DE89014167/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

For twenty years Hanford has been the chief producer of plutonium in the United States and in this capacity has made a major contribution to the security of this country. However, in the past few years it has become increasingly apparent that stockpile requirements of this material were declining and that a reduction in plutonium production was inevitable. Recognizing that shutdown of reactors and supporting facilities could have an unfavorable impact on the local economy, the Atomic Energy Commission has undertaken, in the past two years, a number of steps to stimulate diversification of the economic base of the region. One of the steps was establishment by AEC Headquarters of the "Atomic Energy Commission-General Electric Company (AEC-GE) Study Group for the Economic Development of Richland," consisting of P.G. Holsted, AEC, and F.W. Albaugh, GE. In the course of its work, the Study Group concluded that a concise, but relatively comprehensive, description of the facilities at Hanford would be useful for use in diversification activities and, therefore, arranged for the complication and publication of this document.

38932 (JAERI-M–89-009) **CASKETSS: a computer code system for thermal and structural analysis of nuclear fuel shipping casks.** Ikushima, Takeshi. Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1989. 227p. (In Japanese). Order Number DE89790944/JAW. Available from NTIS (US Sales Only), PC A11/MF A01.

A computer program CASKETSS has been developed for the purpose of thermal and structural analysis of nuclear fuel shipping casks. CASKETSS measn a modular code system for CASK Evaluation code system Thermal and Structural Safety. Main features of CASKETSS are as follow; (1) Thermal and structural analysis computer programs for one-, two-, three-dimensional geometries are contained in the code system. (2) Some of the computer programs in the code system has been programmed to provide near optimal speed on vector processing computers. (3) Data libralies fro thermal and structural analysis are provided in the code system. (4) Input data generator is provided in the code system. (5) Graphic computer program is provided in the code system. In the paper, brief illustration of calculation method, input data and sample calculations are presented.

38933 (K/CSD/TM–86) **Items On Loan System (IOLS) user's manual for Oak Ridge National Laboratory.** Schwarz, R. L. (ed.); Harris, J.R. Oak Ridge Gaseous Diffusion Plant, TN (USA). Jun 1989. 20p. Sponsored by DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89014402/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Items on Loan System (IOLS) is a series of microcomputer-based input, update, and report programs that track the location and loan status of hard-copy engineering documents under the custodial care of the Information Services Division (ISD) of Martin Marietta Energy Systems, Inc. This IOLS user's guide provides instruction on the use of these programs. This manual presents an overview of the IOLS, describing the system's purpose; the data that it handles; functions it performs; hardware, software, and access; reports; and help and error functions. This paper also describes the interactive menu-driven operation of the IOLS.

38934 (SAND–88-1006) **CONCHAS users manual.** Mills-Curran, W.C.; Flanagan, D.P. Sandia National Labs., Albuquerque, NM (USA). Jun 1989. 68p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89014379/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

CONCHAS is a linear finite element structural analysis code which is specialized for axisymmetric structures. Loads and responses are limited to those symmetric about a plane which includes the symmetric axis of the structure. CONCHAS will perform eigenanalysis, static analysis and dynamic analysis. The element library includes consistent-mass shell, solid, and beam elements, nonlinear springs, and concentrated masses. Pre and postprocessing is available with the separately supported utilities BLOT, PATRAN, and FASTQ. 10 refs., 6 figs., 5 tabs.

38935 (SAND–88-1304C) **Discrete enforcement of uncertain oscillator Gaussian response.** Branstetter, L.J.; Jeong, G.D. Sandia National Labs., Albuquerque, NM (USA). 1989. 8p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890835–1: 5. international conference on structural safety and reliability, San Francisco, CA, USA, 8-11 Aug 1989). Order Number DE89005595/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A limited number of step-by-step procedures have been developed to recursively evaluate the response moments of uncertain systems. In several of these procedures, the recursive evaluation depends on discrete enforcement of a Gaussian approximation to the displacement and velocity response random processes. In this paper, the error associated with such an approximation is isolated for a simple system using an analytic method which is not itself approximate in the manner of perturbation or Monte Carlo approaches. 6 refs., 2 figs.

38936 (SAND–88-2876C) **Model based damping of coupled horizontal and vertical oscillations in a flexible rod.** Petterson, B.J.; Robinett, R.D. Sandia National Labs., Albuquerque, NM (USA). 1989. 24p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890818–3: Guidance, navigation, and control conference, Boston, MA, USA, 14-16 Aug 1989). Order Number DE89007034/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper reviews the theory associated with vibrations of angularly accelerated cantilevered beams which display significant gravitational sag (coupling the out-of-plane dynamics of the flexible beam) and formulates a control approach for moving such beams to damp residual first horizontal and vertical modes of oscillation. An experimental implementation of the control strategy using an open-loop, single axis torque that is shaped for simultaneous damping of the horizontal and vertical vibrations is described. The experimental control strategy demonstrates more than 99% reduction in the coupled residual vibrations. 9 refs., 5 figs., 1 tab.

38937 (SAND–88-3310C) **Two-dimensional single fluid MHD simulations of plasma opening switches.** Roderick, N.F.; Payne, S.S.; Peterkin, R.E. Jr.; Frese, M.H.; Hussey, T.W. Sandia National Labs., Albuquerque, NM (USA). 1989. 10p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890710–16-Draft: 5. international conference on megagauss magnetic field generation and related topics, Novosibirsk, USSR, 3-7 Jul 1989). Order Number DE89014491/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Simulations of plasma opening switch have been made using two-dimensional, single fluid, magnetohydrodynamic codes HAM and MACH2. A variety of mechanisms for magnetic field penetration have been investigated. These include plasma convection, classical and microturbulent resistive diffusion, and Hall effect transport. We find that plasma microturbulent models are necessary to explain the broad current channels observed in experiments. Both heuristic and consistent microturbulent models are able to explain observed channel widths and penetration features. The best results are obtained for a consistent model that includes the Buneman, ion acoustic, and lower hybrid microturbulent collision frequencies and threshold conditions. Maximum microturbulent collision frequencies of 5 ω_p, are typical. Field transport and current channel profiles are in excellent agreement with experimental observations for GAMBLE I, GAMBLE II, and SUPERMITE experiments. Dominant field penetration mechanisms and center of mass plasma motion are current and density dependent. Including the Hall effect enhanced field penetration. Center of mass motion is negligible for the GAMBLE I experiments but significant for the GAMBLE II conditions. Scaling of plasma opening time with switch length and density can be fit by linear representations for lengths from 0.03 m to 0.24 m and ion densities from $10^{18} m^{-3}$ to $1.5 \times 10^{19} m^{-3}$. 15 refs., 7 figs., 1 tab.

38938 (SAND–88-3383) **Exact solutions for symmetric deformations of hollow bodies of ideal fluids with application to inertial stability.** Passman, S.L.; Grady, D.E. Sandia National Labs., Albuquerque, NM (USA). May 1989. 33p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89014374/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We present solutions for the problems of radial motion of spherical and cyclindrical bodies of an incompressible inviscid fluid, with an initial kinetic energy, and subjected to pressure on the outer (or equivalently, inner) boundary. These solutions have bearing on the inertial stability of ejecta in hypervelocity impact and of explosively compressed shells. 15 figs.

38939 (SAND–89-0195C) **An optimal projection controller for an experimental truss structure.** Peterson, L.D. Sandia National Labs., Albuquerque, NM (USA). 1989. 31p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890818–2: Guidance, navigation, and control conference, Boston, MA, USA, 14-16 Aug 1989). Order Number DE89006723/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An Optimal Projection reduced order controller is designed and implemented on an experimental controlled structure testbed. Twenty modes of the test structure lie within the controller bandwidth. Four strain sensor signals are fed back through an eighteenth order dynamic controller into four stress actuators (not collocated with the sensors) to reduce the vibration of the structure. Five independent performance measures are simultaneously minimized with an Optimal Projection controller derived from a 58th order state space model. The controller reduces the RMS vibration response by up to 65% without saturating the actuators and without destabilizing high frequency modes. The Optimal Projection controller always performs better than a sub-optimal controller based on ordinary Linear Quadratic Gaussian theory. The homotopy algorithm used to solve the Optimal Projection synthesis equations is described, and both analytical and experimental results are presented. 26 refs., 6 figs., 5 tabs.

38940 (SAND–89-0345C) **Full-scale aircraft impact test for evaluation of impact forces: Part 1, Test plan, test method, and test results.** von Riesemann, W.A.; Parrish, R.L.; Bickel, D.C.; Heffelfinger, S.R.; Muto, K.; Sugano, T.; Tsubota, H.; Koshika, N.; Suzuki, M.; Ohrui, S. Sandia National Labs., Albuquerque, NM (USA). Mar 1989. 9p. DOE Contract AC04-76DP00789. (CONF-890855–6: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA, USA, 14-18 Aug 1989). Order Number DE89009329/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

One of the factors considered in the design of critical concrete structures is the estimation of the global elasto-plastic structural response caused by the accidental impact of an aircraft. To estimate the response of the structure, the impact force (the force versus time relationship) must be known. Previous analytical studies have derived the forcing function using the impact velocity of the aircraft and the calculated mass and strength distribution of the aircraft. This paper describes a test conducted on April 19, 1988, at an existing rocket sled facility at Sandia National Laboratories in Albuquerque, New Mexico, USA, in which an actual F-4 Phantom aircraft was impacted at a nominal velocity of 215 m/s into an essentially rigid block of concrete. This was accomplished by supporting the F-4 on four struts that were attached to the sled track by carriage shoes to direct the path of the aircraft. Propulsion was accomplished by two stages of rockets. The concrete target was 'floated' on a set of air bearings. Data acquisition consisted of measurements of the acceleration of the fuselage and engines of the F-4, and measurements of the displacement, velocity and acceleration of the concrete target. High-speed photography recorded the impact process and

also permitted the determination of the impact velocity. This paper describes the test plan, method and results, while a companion paper discusses the analyses of the results. 6 refs., 11 figs.

38941 (SAND–89-0359C) **Measurement errors for thermocouples attached to thin plates: Application to heat flux measurement devices.** Sobolik, K.B.; Keltner, N.R.; Beck, J.V. Sandia National Labs., Albuquerque, NM (USA). 1989. 22p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890819–6: ASME/AIChE national heat transfer conference, Philadelphia, PA (USA), 6-9 Aug 1989). Order Number DE89007420/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Unsteady Surface Element (USE) methods are applied to a model of a thermocouple wire attached to a thin disk. Green's functions are used to develop the integral equations for the wire and the disk. The model can be used to evaluate transient and steady state responses for many types of heat flux measurement devices including thin skin calorimeters and circular foil (Gardon) heat flux gages. The model can accommodate either surface or volumetric heating of the disk. The boundary condition at the outer radius of the disk can be either insulated or constant temperature. Effect on the errors of geometrical and thermal factors can be assessed. Examples are given. 24 refs., 11 figs.

38942 (SAND–89-0360C) **The radiative-convective partitioning of heat transfer to objects in large pool fires.** Nakos, J.T.; Keltner, N.R. Sandia National Labs., Albuquerque, NM (USA). 1989. 29p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890819–5: ASME/AIChE national heat transfer conference, Philadelphia, PA, USA, 6-9 Aug 1989). Order Number DE89007429/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper explores the relative contributions of radiative and convective heat transfer to objects in large pool fires. The partitioning process depends on many factors. Results include measurements of the temperature of the objects in the fire, the flames surrounding the object, the total heat flux to the objects and the radiative component of the heat transfer at a few locations using transpiration radiometers. These measurements will be compared with calculations. Agreement between the measured radiative heat flux and the calculated radiative heat flux is good. The convective contribution was calculated from the total and radiative parts and was found to be from 10–20% of the total. 18 refs., 18 figs.

38943 (SAND–89-0619C) **Full-scale aircraft impact test for evaluatioin of impact force: Part 2: Analysis of results.** Muto, K.; Sugano, T.; Tsubota, H.; Koshika, N.; Suzuki, M.; Ohrui, S.; von Riesemann, W.A.; Bickel, D.C.; Parrish, R.L.; Tachau, R.D.M. Sandia National Labs., Albuquerque, NM (USA). 1989. 6p. Sponsored by DOE Nuclear Energy. DOE Contract AC04-76DP00789. (CONF-890855–13: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA, USA, 14-18 Aug 1989). Order Number DE89009335/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

For estimating the global elasto-plastic structural response of critical concrete structures subjected to an aircraft crash, the time dependent impact force of a flat rigid barrier against a normally impacting aircraft was first evaluated and then the response, to the impact force, was calculated. In this approach, a significant problem was to determine the impact force for the aircraft against a rigid target. A review of the method proposed to determine the impact forces showed that all were based on analytical methods. However, in these analytical methods, there were many assumptions and many questions remained to be answered. Because of the uncertainty involved in the analytical prediction of the impact force, a full-scale aircraft impact test was performed and an extensive suite of response measurements was obtained. In this paper, these measurements are analyzed to evaluate the impact force accurately. Also, the results were used to evaluate existing analytical methods for prediction of the impact force. 7 refs., 10 figs.

38944 (SAND–89-0927) **REGGIE results for the Nunnally mass launcher.** Freeman, J.R. Sandia National Labs., Albuquerque, NM (USA). Jun 1989. 14p. Sponsored by DOE Energy Research. DOE Contract AC04-76DP00789. Order Number DE89014377/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report presents preliminary analyses of the Nunnally mass launcher. The Nunnally launcher is much like ones described in US Patents 1,370,200; 1,421,435; and 1,422,427 which were issued to A.L.O. Fauchon-Villeplee in the period 1917–1922. A discussion of why a high conductivity projectile impulsively accelerated in a uniform transverse B-field does not experience a drag force, even for very large magnetic Reynolds numbers ($R_m = 10^2 - 10^4$) is also presented. 1 ref., 7 figs.

38945 (SAND–89-1087) **Robotic grasping of unknown objects: A knowledge-based approach.** Stansfield, S.A. Sandia National Labs., Albuquerque, NM (USA). Jun 1989. 48p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89013875/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In this paper, we demonstrate a general-purpose robotic grasping system for use in unstructured environments. Using computer vision and a compact set of heuristics, the system automatically generates the robot arm and hand motions required for grasping an unmodeled object. The utility of such a system is most evident in environments where the robot will have to grasp and manipulate a variety of unknown objects, but where many of the manipulation tasks may be relatively simple. Examples of such domains are planetary exploration and astronaut assistance, undersea salvage and rescue, and nuclear waste site clean-up. This work implements a two-stage model of grasping: stage one is an orientation of the hand and wrist and a ballistic reach toward the object; stage two is hand preshaping and adjustment. Visual features are first extracted from the unmodeled object. These features and their relations are used by an expert system to generate a set of valid reach/grasps for the object. These grasps are then used in driving the robot hand and arm to bring the fingers into contact with the object in the desired configuration. Experimental results are presented to illustrate the functioning of the system. 27 refs., 38 figs.

38946 (SAND–89-1779C) **PATRAM'89: The ninth international symposium on the packaging and transport of radioactive materials.** Steigler, J.E.; Ammerman, D.J. Sandia National Labs., Albuquerque, NM (USA). 1989. 4p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890736–49: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, FL (USA), 9-12 Jul 1989;TTC–0927). Order Number DE89014898/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Since 1962 the US Department of Energy (USDOE) and its predecessor organizations have supported and participated in a series of triennial scientific and technical symposia known as PATRAM, an acronym for the Packaging and Transportation of Radioactive Materials. The purpose of these symposia is to bring together, on an international basis, experts from industry, government, and research organizations to exchange technical information relating to all aspects of the packaging, testing and transport of radioactive materials. Through the sustained excellence of their programs, these symposia have become the premier domestic and international forums for this increasingly important technical field. Worldwide, PATRAM is the only symposium that is devoted entirely to this subject. The Symposia began in December 1962 with a US Atomic Energy Commission meeting held in Germantown, MD, with 20 papers and representatives from five countries.

38947 (UCRL–50007-87, pp. 79-85) **Recent improvements in the measurement of respirator fit factors.** da Roza, R.A. Lawrence Livermore National Lab., CA (USA). Jul 1988. In *Hazards Control Department annual technology review, 1987.* Order Number DE89002470/JAW. Available from NTIS, PC A07/MF A01.

Respirator fit factors as presently measured may be as much as two times higher or lower than the true value. Ideally, a fit factor would be measured with a perfectly mixed sample, an aerosol that has no losses, and a detector with the same response to all particle sizes. However, a sample taken from inside the facepiece may be unrepresentative due to streamlining, and the polydisperse aerosol currently used in fit testing is partially lost in the lungs and mask. Experiments here show this loss to be about 65% for particles with a diameter of 1 μm. Since the forward-light-scattering photometer

normally used for fit testing is more sensitive to these larger particles in the polydisperse aerosol, the photometer reading from inside the mask is about 65% low. The authors designed an exhalation-valve sampler to give well-mixed samples, and also designed and built a slit impactor with a cutoff of 0.42 μm. When compared to the present impactor with a 0.1-inch diameter circular nozzle, the new design decreases the concentration of particles larger than 0.55 μm by more than a factor of ten. Using the new impactor in fit testing results in a photometer signal that is much less affected by lung loss and thus gives a truer fit factor. 5 references, 8 figures, 1 table.

38948 (UCRL–100939) **Automatic digitization of flash x rays: Applying a new technology to an old diagnostic.** Lee, C.G.; Osher, J.E.; Haskins, J.; Rikard, R.D. Lawrence Livermore National Lab., CA (USA). 30 May 1989. 12p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890885–1: Flash radiography topical symposium, Portland, OR (USA), 15-18 Aug 1989). Order Number DE89013808/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

By digitizing the radiographs of targets we take before and after impact for our electric gun experiments, we have greatly improved both the quality of the information we receive from our flash x-ray machine. This new technology enables us to extract more information than ever before and do it accurately and efficiently. A charge-coupled-device (CCD) camera changes the radiograph images to analog signals, which are then converted to digital signals for processing in our MicroVAX and VAX computers. A signal-processing program called VIEW manipulates the signals and produces color-enhanced images that are displayed on color monitors. Analysis of these images results in quicker and more efficient data extraction; the addition of color adds new dimensions to our interpretation of the information. 1 ref., 8 figs.

38949 (UCRL–101264) **Data acquisition errors and the choice of filter in filtered backprojection algorithms.** Schneberk, D.; Martz, H.; Azevedo, S.; Skeate, M. Lawrence Livermore National Lab., CA (USA). Jun 1989. 9p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8907107–2: American Society of Nondestructive Testing topical conference, Seattle, WA (USA), 24-27 Jul 1989). Order Number DE89014051/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In this paper, we examine issues specific to Filtered Backprojection (FBP) algorithms. While FBP techniques can perform quality image reconstructions, in an economical way, FBP algorithms can produce troublesome artifacts in image reconstructions. At LLNL we have investigated artifacts which result from errors in the measurement of the center of rotation, bad pixels in the projection data (the sinogram), the choice of filter used in the reconstruction code, and difficulties resulting from combinations of these effects. This paper is divided into five sections: a presentation of some fundamentals of computed tomography, and FBP algorithms, a characterization and discussion of centering errors, the effects of singularly-bad pixels, a section on the consequences of choosing different filters in the FBP algorithms in the DONNER library of CT reconstruction routines, and a summary discussion on CT data analysis in industrial inspections. 7 refs., 2 figs.

38950 (WHC-SA–0655) **The transportation management division institutional program: Networking and problem solving.** McGinnis, K.A.; Peterson, J.M. Westinghouse Hanford Co., Richland, WA (USA). Jun 1989. 6p. Sponsored by DOE Defense Programs. DOE Contract AC06-87RL10930. (CONF-890736–45: 30. annual meeting of the Institute of Nuclear Materials Management, Orlando, FL, USA, 9-12 Jul 1989). Order Number DE89014950/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The US Department of Energy (DOE) has several programs related to transportation. While these programs may have differing missions and legislative authority, the required activities are frequently similar. To ensure a DOE-wide perspective in developing transportation policies and procedures, a DOE Transportation Institutional Task Force (Task Force) has been formed, which is the primary focus of this paper. The Task Force, composed of representatives from each of the major DOE transportation programs, meets periodically to exchange experiences and insights on institutional issues related to Departmental shipping. The primary purpose of the group is to identify opportunities for productive interactions with the transportation community, including interested and affected members of the public. This paper will also focus sharply on the networking of DOE with the State, Tribal, and local officials in fostering better understanding and in solving problems. An example of such activity is the DOE's cooperative agreement with the Energy Task Force of the Urban Consortium. A major effort is to encourage cooperative action in identifying, addressing, and resolving issues that could impede the transportation of radioactive materials.

38951 **Motion of a single superconducting vortex.** Hyun, O. B. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011(US)); Clem, J. R.; Finnemore, D. K. *Physical Review [Section] B: Condensed Matter (USA)*, 40(1): 175-181 (1 Jul 1989). DOE Contract W-7405-ENG-82.

Procedures have been developed to trap a single quantized vortex in asuperconducting thin film and systematically move it around under the influenceof an applied Lorentz force. The location of the vortex is determined from thediffraction pattern of a Josephson junction formed by superconducting crossstrips and a normal-metal barrier; the force is applied by a current in thesuperconducting film. Vortices move across the junction in a reproducibleseries of discrete steps, typically a few micrometers long. The elementarypinning force is found to be approximately 10^{-6} N/m in aPb-Bi film and to vary as $(1-t)^{3/2}$, where t isthe reduced temperature. By controlling the pinning sites along a symmetry axisof the junction, one can perform rather simple read and write operations forlogic elements.

38952 **Devoret, Martinis, and Clarke reply.** Devoret, M. H. (Service de Physique du Solide et de Resonance Magnetique, Centre d'Etudes Nucleaires de Saclay, 91191 Gif-sur-Yvette CEDEX, France(FR)); Martinis, J. M.; Clarke, J. *Physical Review Letters (USA)*, 63(2): 212-212 (10 Jul 1989).

A reply to the comment on macroscopic quantum tunneling out of zero– voltage state of acurrent–biased josephson junction is given.It is blieved that the authors data strongly disprove the classical theory and are con– sistent with the quantum theory. (AIP)

38953 **Numerical simulation of experimental data from planar SIS mixers with integrated tuning elements.** Mears, C.A. (Materials and Chemical Sciences Div., Lawrence Berkeley Lab., Berkeley, CA (US)); Hu, Q.; Richards, P.L. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics (USA)*, 25(2): 1050-1053 (Mar 1989). (CONF-880812–: Applied superconductivity conference, San Francisco, CA, USA, 21-25 Aug 1988).

The authors have used the full Tucker theory including the quantum susceptance to fit data from planar lithographed mm-wave mixers with bow tie antennas and integrated RF coupling elements. Essentially perfect fits to pumped IV curves have been obtained. The deduced imbedding admittances agree well with those independently calculated from the geometry of the antenna and matching structures. The authors find that the quantum susceptance is essential to the fit and thus to predictions of the mixer performance. For junctions with moderately sharp gap structures, the quantum susceptance is especially important in the production of steps with low and/or negative dynamic conductance.

38954 **MM wave quasioptical SIS mixers.** Hu, Q. (1100000); Mears, C.A.; Richards, P.L.; Lloyd, F.L. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics (USA)*, 25(2): 1380-1383 (Mar 1989). (CONF-880812–: Applied superconductivity conference, San Francisco, CA, USA, 21-25 Aug 1988).

The authors have tested the performance of planar SIS mixers with log-periodic antennas at near millimeter and submillimeter wave frequencies from 90 to 360 GHz. The large $-R_NC$ product (–10 at 90 GHz,) of our $Nb/NbO_x/Pb$-In-Au junctions requires an integrated inductive tuning element to resonate the junction capacitance at the operating frequencies. They used two types of integrated tuning element, which were designed with the aid of measurements using a Fourier transform spectrometer. Preliminary results indicate that the tuning elements can give very good mixer performance up to at least 200GHz. An inductive wire in parallel with a 5-junction array gives a minimum mixer noise temperature of

115K (DSB) at 90GHz with a FWHM bandwidth of 8GHz. An open-ended microstrip stub in parallel with a single junction, gives minimum mixer noise temperatures of 150 and 200K (DSB) near 90 and 180GHz with FWHM bandwidths of 4 and 3GHz respectively. The relatively high mixer noise temperatures compared to those of waveguide SIS mixers in a similar frequency range are attributed mainly to the losses in our optical system, which is being improved.

38955 . Magnetic structure for a superconducting variable frequency electron cyclotron resonance ion source. Antaya, T.A. (4114000); Zeller, A.F.; Moskalik, J.M.; Blosser, H.G.; Nolen, J.A.; Harrison, K.A. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics (USA),* 25(2): 1671-1675 (Mar 1989). (CONF-880812–: Applied superconductivity conference, San Francisco, CA, USA, 21-25 Aug 1988).

Electron cyclotron resonance (ECR) ion sources are, at present, the leading source of highly charged dc beams of positive ions. Fully stripped light ions through argon have been obtained, and ionization levels of 25-35 electrons removed have been obtained for heavy mass species. Major applications of ECR ion sources for highly charged ions now include approximately 30 nuclear, atomic and high energy physics laboratories world-wide. For electrons, the rotation frequency is 2.8 GHz per kilogauss of magnetic field. Most ECR ion sources have used klystrons in the frequency range of 6-14 GHz as the microwave sources, with corresponding resonance fields of 2-5 kG, and peak mirror fields at the ends and side walls that are at most 8 kG. These sources have used hollow copper coils for the axial mirror in combination with a rare earth permanent magnet hexapole for the radial magnetic field. At higher resonance frequencies, superconducting magnet designs are competitive both in terms of construction and operating cost.

38956 A unique cabling machine designed to produce rutherford-type superconducting cable for the SSC project. Grisel, J. (9901800); Royet, J.M.; Scanlan, R.M.; Armer, R. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics (USA),* 25(2): 1608-1610 (Mar 1989). (CONF-880812–: Applied superconductivity conference, San Francisco, CA (USA), 21-25 Aug 1988).

Up to 25,000 Km of keystoned flat cable must be produced for the SSC project. Starting from a specification developed by Lawrence Berkeley Laboratory (LBL), a special cabling machine has been designed by Dour Metal. It has been designed to be able to run at a speed corresponding to a maximum production rate of 10 m/min. This cabling machine is the key part of the production line which consists of a precision Turkshead equipped with a variable power drive, a caterpillar, a dimensional control bench, a data acquisition system, and a take-up unit. The main features of the cabling unit to be described are a design with nearly equal path length between spool and assembling point for all the wires, and the possibility to run the machine with several over- or under-twisting ratios between cable and wires. These requirements led Dour Metal to the choice of an unconventional mechanical concept for a cabling machine.

38957 Analysis of the capacitive coupling of Josephson transmission lines. Cirillo, M. (Theoretical Division and Center for Nonlinear Studies, Los Alamos National Laboratory, Los Alamos, New Mexico 87545(US)); Bishop, A. R.; Lomdahl, P. S.; Pace, S. *Journal of Applied Physics (USA),* 66(4): 1772-1776 (15 Aug 1989).

We study the capacitive coupling of two long Josephson junctions by imposing appropriate boundary conditions at the ends of the junctions. Numerical simulations show good agreement with analytical estimates of the parameter range for which reflections of fluxons at the coupled end of the junction occur. We discuss our results in terms of recent experiments concerning phase-locking phenomena in Josephson junctions fluxon oscillators devices.

38958 Quench pressure, thermal expulsion, and normal zone propagation in internally cooled superconductors. Dresner, L. (4832000). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics (USA),* 25(2): 1710-1712 (Mar 1989). (CONF-880812–: Applied superconductivity conference, San Francisco, CA, USA, 21-25 Aug 1988).

When a nonrecovering normal zone appears in an internally cooled superconductor, the pressure in the conductor rises, helium is expelled from its ends, and the normal zone grows in size. This paper presents a model of these processes that allows calculation of the pressure, the expulsion velocity, and the propagation velocity with simple formulas. The model is intended to apply to conductors such as the cable-in-conduit conductor of the Westinghouse LCT (WH-LCT) coil, the helium volumes of which have large length-to-diameter ratios (3×10^5). The predictions of the model agree with rather limited data available from propagation experiments carried out on the WH-LCT coil.

38959 Nb_3Al wire produced by powder metallurgy and rapid quenching from high temperatures. Thieme, C.L.H. (9510048); Pourrahimi, S.; Foner, S. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics (USA),* 25(2): 1992-1995 (Mar 1989). (CONF-880812–: Applied superconductivity conference, San Francisco, CA, USA, 21-25 Aug 1988).

Powder metallurgy processed Nb-25at%Al wires were annealed at temperatures just below the melting temperature. Depending on anneal conditions, the entire Nb-Al part of the wire could be rapidly quenched as a metastable A2 Nb(Al) solid solution with an Al concentration exceeding 23at%. This A2 phase is sufficiently ductile to be bent without incurring damage. A second anneal at 950°C converted the A2 into A15. J_c was 10^4 A/cm^2 at 22 T, and T_c was 17.8 K. The rapid quenching of Nb-Al powder metallurgy processed wire is a possible alternative to obtain improved high field properties.

38960 Further studies of a laser quenched superconducting opening switch. Francavilla, T.L. (4563000); Nelson, H.H.; Baronavski, A.P.; Wolf, S.A.; Gubser, D.U.; Hein, R.A. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics (USA),* 25(2): 1996-1999 (Mar 1989). (CONF-880812–: Applied superconductivity conference, San Francisco, CA, USA, 21-25 Aug 1988).

The authors have prepared NbN films on planar sapphire, and on small diameter cylindrical quartz and sapphire substrates. Films prepared on cylindrical substrates had a greater critical current density than those prepared on planar substrates. Our highest current densities of $1X10^7$ A/cm^2 were achieved on cylindrical sapphire substrates. Measurements of the laser powder required to drive the switch into the normal state were made as a function of current being carried by the NbN clad sapphire rod. These experiments indicated that near J_c very small amounts of laser energy were needed to drive the sample normal as expected. At current values well below J_c much larger energies were required. These large energies, which are roughly 10^3 larger than the condensation energy, were attributed to heating of the sapphire rod necessary to raise the NbN above its transition temperature. The desirable properties of a superconducting switch are the ability to carry large currents in the superconducting state and have a high resistance to the normal state. Considerations for using the high-T_c oxides in a superconducting switch are examined.

38961 Experimental study of flux pinning in NbN films and multilayers. Gray, K.E. (9502104); Kampwirth, R.T.; Capone, D.W. II; Murduck, J.M. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics (USA),* 25(2): 2060-2067 (Mar 1989). (CONF-880812–: Applied superconductivity conference, San Francisco, CA, USA, 21-25 Aug 1988).

A flux pinning model is presented which predicts the maximum critical current density attainable in superconductors. That such a limit must exist comes from the realization that flux pinning is strongest in regions of weak superconductivity, but these regions cannot carry a large supercurrent. Since the same regions within the superconductor cannot be used for both pinning and supercurrent conduction, there must be an optimum mix, leading to a maximum J_c. Measurements on films and multilayers of NbN have verified many details of the model including anisotropy effects and a strong reduction in J_c for defect spacings smaller than the flux core diameter. In an optimized multilayer the pinning force reached ~ 22% of the theoretical maximum. The implications of these results on the practical applications of NbN films and on the maximum critical current density in the new high temperature superconductors are also discussed.

38962 Neutron irradiation of sputtered NbN films. Weber, H.W. (Atominstitut der Osterreichischen Univ., Schuttelstrasse 115, A-1020 Wien (AT)); Gregshammer, P.; Gray, K.E.; Kampwirth, R.T.

IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics (USA), 25(2): 2080-2083 (Mar 1989). (CONF-880812–: Applied superconductivity conference, San Francisco, CA, USA, 21-25 Aug 1988).

In addition to the excellent high-field superconducting properties of NbN, it is the strain and radiation tolerance, measured in bulk NbN, which makes the material so attractive for large high-field magnets, especially for fusion applications. The authors report neutron irradiation experiments on sputtered NbN films, up to a fluence of 10^{23} m^{-2} (E > 0.1 MeV), which prove that NbN films are also extremely radiation-hard high-field superconductors. Both the transition temperatures, T_c, and the normal state resistivities show only small changes with neutron fluence. Concerning the critical current densities, j_c, degradations by as much as 30% are observed at low fields, whereas in an intermediate field range (11-15 T) virtually no change of j_c and at high fields near 20 T even an increase of j_c are found. The latter observation is ascribed to a radiation-induced increase of the upper critical field, B_{c2}, and to the occurence of peak effects near B_{c2}.

38963 Magnetic shielding by superconducting Y-Ba-Cu-O hollow cylinders. Willis, J.O. (9512470); McHenry, M.E.; Maley, M.P.; Sheinberg, H. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics (USA)*, 25(2): 2502-2505 (Mar 1989). (CONF-880812–: Applied superconductivity conference, San Francisco, CA (USA), 21-25 Aug 1988).

The authors have measured the magnetic field H' at the center of a hollow tube of sintered Y-Ba-Cu-O superconductor as a function of applied field H, temperature, tube length, and tube wall thickness. The maximum field that can be shielded H_{sh} agrees with the value calculated from the critical state model using the measured critical current density J_c. The maximum trapped H_{tr} in the tube upon decreasing H to zero exceeds H_{sh} by as much as a factor of two, and large enhancements in J_c are observed in decreasing field. These phenomena are identified with intragranular flux pinning present only after H has exceeded H_{cl} of he grains. Finite tube length does not affect the $H_{tr}H_{sh}$ ratio appreciably. H_{sh} depends approximately on the square root of the wall thickness.

4203 Lasers

Refer also to citation(s) 38688, 38835, 38843, 39012, 39099, 39164, 39680, 39684, 39753

38964 (GAO/NSIAD–88-181BR) **Strategic defense initiative program.** General Accounting Office, Washington, DC (USA). National Security and International Affairs Div. 1988. 16p. Available from US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

Allegations have been made that technical information about the X-ray laser research program being carried out at the Lawrence Livermore National Laboratory as part of the Strategic Defense Initiative program was misrepresented to the Administration. LLNL is operated by the University of California under a contract with the Department of Energy. After getting opinions from selected LLNL scientists who had specific knowledge about the X-ray laser program as to the allegations, GAO concluded there was no general agreement among these scientists concerning the accuracy of the statements.

38965 (SAND–89-0248C) **Neutron effects in high-power semiconductor laser diodes.** Carson, R.F.; Chow, W.W. Sandia National Labs., Albuquerque, NM (USA). 1989. 7p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890723–9: 26. annual conference on nuclear and space radiation effects, Marco Island, FL, USA, 24-28 Jul 1989). Order Number DE89015493/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

High-power semiconductor laser diodes exhibit a large tolerance to neutron bombardment up to 10^{14} n/cm^2. Large (100–250%) increases in threshold current and a raised susceptibility to facet damage are observed at 10^{15} n/cm^2. 9 refs., 9 figs.

38966 Axial and conical parametric four-wave mixing in pure Na vapor. Moore, M.A. (Oak Ridge National Lab., Oak Ridge, TN (US)); Garrett, W.R.; Payne, M.G. v.v of Proceedings of the conference on lasers and electro-optics. Optical Society of America, Washington, DC (1988). (CONF-880402–: CLEO '88: OSA/IEEE conference on lasers and electro-optics, Anaheim, CA, USA, 25-29 Apr 1988).

Typical parametric four-wave mixing (PFWM) processes are well documented in Na vapors. These processes in general involve emissions that are nonresonant in nature and must satisfy the phase matching conditions ($\Delta\kappa = 0$, where $\Delta\kappa$ is the phase mismatch between the laser and generated photons) by adjusting the angles of the κ vectors of the generated waves. This results in the production of conically emitted light about the axis of the pump laser and only in the direction of the laser photons. In addition, there is a distribution in frequency near, but not on, the resonant frequencies. The authors demonstrate both experimentally and theoretically that in certain circumstances other criteria for FWM exist in alkali vapors that allow for axial as well as conical production of PFWM. In the case of axial production of PFWM, codirectional phase matching can occur in a narrow frequency region where the dispersion goes through zero, but the susceptibility is large. For generation near the two-photon resonance with Na4d, where the laser frequency is near a one-photon resonance, the axial process can occur in two places near 4d → 4p frequencies.

38967 Precise calculation of linewidth reduction in wavelength-detuned distributed feedback semiconductor lasers. Kikuchi, K. (Univ. of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113 (JP)). v.v of Proceedings of the conference on lasers and electro-optics. Optical Society of America, Washington, DC (1988). (CONF-880402–: CLEO '88: OSA/IEEE conference on lasers and electro-optics, Anaheim, CA, USA, 25-29 Apr 1988).

The authors propose a novel method for the precise calculation of the linewidth reduction due to wavelength detuning. The most important point of the proposed method is that δf_{ST} is determined from the AM noise spectrum. The authors used 1.3-μm DFB lasers (Fujitsu) in the experiment with wavelength detuning $\Delta\lambda$ = -15 nm (laser A) and $\Delta\lambda$ = +15nm (laser B). The rippling curve is a typical example of the measured AM noise spectra of laser B. The normalized bias current $(I-I_{th})/I_{th}$ is 0.34 in this example. The smooth curve is the theoretical one. The three-parameter values obtained by the curve fitting are: δf_{ST} = 1.90 MHz; f_R = 1.95 GHz; and $\gamma/2\pi$ = 0.65 GHz. Open circles and dots show δf_{ST} of lasers A and B, respectively, measured as functions of I_{th}(I - I/th), which is proportional to the inverse power.

38968 High-efficiency second-to-fourth harmonic conversion in KDP. Chaffee, P.H. (Lawrence Livermore National Lab., P.O. Box 5508, Livermore, CA (US)); Ehrlich, R.B. v.v of Proceedings of the conference on lasers and electro-optics. Optical Society of America, Washington, DC (1988). (CONF-880402–: CLEO '88: OSA/IEEE conference on lasers and electro-optics, Anaheim, CA, USA, 25-29 Apr 1988).

A motivation for achieving high fourth-harmonic-generation (FHG) conversion efficiencies in glass laser-fusion systems lies in the increased laser-target coupling efficiency at shorter wavelengths. To investigate the factors involved in obtaining high-conversion efficiencies using KDP, the authors set up a laser system consisting of a Nd:YLF oscillator and glass amplifier. They apertured the output Gaussian beam to 1.7 mm to obtain a flat-topped spatial profile. The system produced peak intensities of up to 8 GW/cm^2 in 150-ps Gaussian pulses at the fundamental (1.054-μm) wavelength. Conversion to the second harmonic was achieved in a separate KDP crystal using type II phase matching. With this system, they achieved 80% internal second-to-fourth harmonic conversion efficiency in a type I 1-cm thick KDP crystal. The authors believe this is the highest second-to-fourth harmonic conversion efficiency obtained to date in KDP and attribute it to careful aperturing of the beam to obtain a flat spatial profile.

38969 Performance of a Nova beamline with high-damage threshold glass. Bibeau, C. (Lawrence Livermore National Lab., Livermore, CA (US)); Ehrlich, R.B.; Lawson, J.K.; Laumann, C.W.; Pennington, D.M.; Weiland, T.L.; Henesian, M.A.; Speck, D.R. v.v of Proceedings of the conference on lasers and electro-optics. Optical Society of America, Washington, DC (1988). (CONF-880402–:

CLEO '88: OSA/IEEE conference on lasers and electro-optics, Anaheim, CA, USA, 25-29 Apr 1988).

The Nova laser amplifier system at Lawrence Livermore National Laboratory was designed to deliver 80-120 kJ of 1.05-μm laser radiation in 1.0-3.0-ns pulse-to-frequency conversion crystals. The crystals (type II/typ;e II KDP) convert this efficiently to give 50-80 kJ of second harmonic or 40-70 kJ of third harmonic light, which is focused onto fusion targets in a target chamber. Single-beam and full-system trials done shortly after completion of the facility demonstrated that the laser amplifier and harmonic conversion systems could easily meet these operating goals. The authors are presently prevented from routinely operating at these levels because of the threat of damage to the glass in the output amplifier stages. The laser glass in the amplifiers and the BK-7 optical glass in other components contain a few particles per liter of small metallic platinum inclusions, which cause damage to the glass at fluences exceeding 2.0 J/cm^2. This has caused them to limit energy routinely available from Nova to 50-60 kJ at 1.05 μm, which yields 20-25 kJ of the third harmonic on-target.

38970 **Colquirite doped with Cr^{3+}.** Chase, L.L. (Lawrence Livermore National Lab., Livermore, CA (US)); Payne, S.A.; Newkirk, H.W.; Smith, L.K.; Wilke, G.D.; Shinn, M.D.; Krupke, W.F. v.v of Proceedings of the conference on lasers and electro-optics. Optical Society of America, Washington, DC (1988). (CONF-880402–: CLEO '88: OSA/IEEE conference on lasers and electro-optics, Anaheim, CA, USA, 25-29 Apr 1988).

The authors have investigated the spectroscopic and laser properties of $LiCaAlF_6$, or colquirite, doped with Cr^{3+} ions. The crystal seems quite promising as a laser host, as the material has been observed to crystallize well and to lase with a rather low threshold of 50 mW of pump power when utilizing 1% output coupling. They have conducted preliminary measurements of the slope efficiency with 5% output coupling and have found the values to be comparable with those reported for alexandrite, which is currently recognized to be the most efficient Cr^{3+} solid-state laser. The efficiency of Cr^{3+} lasers is affected by numerous aspects of the laser material. The crystal quality is important, as poor optical characteristics introduce passive losses into the laser cavity. Their sample seems to exhibit low loss, the value being less than a few percent per centimeter. Another potential problem involves the presence of nonradiative decay at the Cr^{3+} site following the absorption of the pump radiation.

38971 **New near-infrared tunable room-temperature laser $La_3Ga_5SiO_{14}:Cr^{3+}$.** Lai, S.T. (Allied-Signal Inc., Morristown, NJ (US)); Chai, B.H.T.; Long, M. v.v of Proceedings of the conference on lasers and electro-optics. Optical Society of America, Washington, DC (1988). (CONF-880402–: CLEO '88: OSA/IEEE conference on lasers and electro-optics, Anaheim, CA, USA, 25-29 Apr 1988).

A new room-temperature tunable laser La_3-$Ga_5SiO_{14}:Cr^{3+}$ (LGS) has been discovered. Laser free-running at 960 nm was observed when longitudinally pumped by a krypton-ion laser at 647.1 nm. The laser tuning range covered from 862 to 1107 nm. Close to 80 mW at 960 nm was measured with ~1.5 W of absorbed pumped power. The fluorescence spectra are broadband characteristics of $^4T_2$ emission from low-field crystal. The fluorescence peak is at 890 nm, further red-shifted from the 820-nm peak in Cr-doped $ScBO_3$. The large red-shifting is unexpected from Cr^{3+} in an octahedral Ga site. The fluorescence lifetime is 5.3 μs at room temperature and increases to 12.1 μs at 5.3 K. The transmission coefficient of LGS:Cr at 638 nm vs temperature was monitored and was found to be practically constant from 150 K up to room temperature. The fluorescence efficiency at room temperature has also been measured. Using the integrated intensity from the fluorescence spectra and corrected for instrumental responses, the authors measured a 31% yield, assuming 100% yield in GSGG:Cr and alexandrite. From the fluorescence yield and transmission measurements, they conclude that the fluorescence lifetime shortening at increasing temperature is due to a nonradiative relaxation process.

38972 **Integration of the Aurora KrF ICF laser system at Los Alamos.** Rosocha, L.A. (Los Alamos National Lab., P.O. Box 1663, Los Alamos, NM (US)); Blair, L.S. v.v of Proceedings of the conference on lasers and electro-optics. Optical Society of America, Washington, DC (1988). (CONF-880402–: CLEO '88: OSA/IEEE conference on lasers and electro-optics, Anaheim, CA (USA), 25-29 Apr 1988).

The Aurora laser system, under construction at the Los Alamos National Laboratory for the past few years, is now being integrated into a working system for examining the applicability of high-power KrF lasers to inertial confinement fusion (ICF). The design principles of the system have been described in detail in earlier publications and conferences. Multikilojoule 248-nm 5-ns duration laser pulses, which have been derived from angular-multiplexed electron-beam-driven KrF amplifiers, are to be delivered to ICF targets when the system is fully integrated. The authors describe the progress of the Aurora system toward the goal of delivering energy (MkJ/48 pulses stacked into one 5-ns pulse/200-μm spot) to ICF targets. Integrated performance to date of the front end optical multiplexer/demultiplexer e-beam-driven amplifiers and alignment hardware are discussed in particular. They have concentrated on the demonstration of system integration at a modest (~100-J) level of energy on-target (without the final amplifier stage). They discuss the amplifier gain measurements, the extraction of energy from a chain of three e-beam-driven machines, and progress toward the delivery of on-target energy.

38973 **Phase conversion for fusion lasers.** Kessler, T. (Univ. of Rochester, Rochester, NY (US)); Castle, W.; Sampat, N.; Skupsky, S.; Smith, D.; Swales, S. v.v of Proceedings of the conference on lasers and electro-optics. Optical Society of America, Washington, DC (1988). (CONF-880402–: CLEO '88: OSA/IEEE conference on lasers and electro-optics, Anaheim, CA (USA), 25-29 Apr 1988).

An essential requirement for direct drive laser fusion is the uniform irradiation of spherical targets that are located in the quasi-far field of a laser system. A major impediment to irradiation uniformity with high-power solid-state laser systems is the presence of a hot-spot structure at the target plane. The hot-spot intensity nonuniformities are caused by spatial variations in the near-field phase front of each laser beam. Although for many tabletop applications diffraction-limited laser performance can be obtained through static phase correction, adaptive optics, or phase conjugation, such approaches are either excessively expensive, difficult to implement, or not yet available for large-aperture, high-peak-power laser beams. An alternative to phase correcting a wavefront involves modifying the laser beam's coherence properties thereby changing its focusing characteristics. The method of induced spatial incoherence (ISI) involves a reduction in both spatial and temporal coherence. Other methods are based on modifications of only the spatial coherence of a laser beam. A phase conversion technology which incorporates a distribution of near-field phases to either perform static phase correction or induce spatial incoherence offers a route toward increasingly higher levels of irradiation uniformity.

38974 **Application of pulse compression and shaping to the FEL photoelectric injector.** Nguyen, D.C. (Los Alamos National Lab., Los Alamos, NM (US)); Watkins, D.E.; Weber, M.E. v.v of Laser optics for intracavity and extracavity applications. Fauchet, P.M.; Guenther, K.H. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-8801107–: Laser optics for intracavity and extracavity applications, Los Angeles, CA, USA, 11-13 Jan 1988).

The authors discuss the application of self-phase modulation and grating pulse compression to the generation of temporally trapezoidal optical pulses for controlling the electron beam emittance and energy spread in an FEL photoelectric injector. Pulse compression in a single-stage pulse compressor, with background reduction based on the nonlinear birefringence of the optical fiber,yields 3-ps, compressed pulses without background pedestals or sidelobes. Trapezoidal, flat-topped pulses with 20-ps FWHM and 4-ps risetime have been obtained through self-phase modulation and group-velocity dispersion of the 3-ps pulses in a second fiber. Pulse shaping through Fourier transform amplitude and phase masking in the frequency domain and the amplification of the trapezoidal pulses are also discussed.

38975 **Liquid crystal optics for laser systems.** Jacobs, S.D. (Lab. for Laser Energetics, Univ. of Rochester, 250 East River Road, Rochester, NY (US)); Cerqua, K.A.; Marshall, K.L.; Schmid, A.; Guardalben, M.J.; Skerrett, K.J. v.v of Laser optics for intracavity and extracavity applications. Fauchet, P.M.; Guenther, K.H. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA

(1988). (CONF-8801107–: Laser optics for intracavity and extracavity applications, Los Angeles, CA, USA, 11-13 Jan 1988).

The authors present an overview of the development of laser optics utilizing liquid crystals. Devices discussed include wave plates, circular polarizers, optical isolators, laser blocking notch filters and laser beam apodizers. Issues addressed include fabrication methods and laser damage resistance.

38976 Abrasion resistant porous silica antireflective coatings. Thomas, I.M. (Lawrence Livermore National Lab., Univ. of California, P.O. Box 5508, L-483, Livermore, CA (US)). v.v of Laser optics for intracavity and extracavity applications. Fauchet, P.M.; Guenther, K.H. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-8801107–: Laser optics for intracavity and extracavity applications, Los Angeles, CA, USA, 11-13 Jan 1988).

The abrasion resistance of a porous silica antireflective coating prepared from a colloidal silica suspension was increased by the addition of a soluble siloxane binder to the suspension prior to application. After evaporation of the solvent this binder served to increase the adhesion between individual silica particles thereby increasing the coating strength. The optimum binder concentration was 20-30% and at this level the optical properties and laser damage threshold of the original silica coating were retained.

38977 Calculations for Ni-like soft x-ray lasers: Optimization for W (43.1 A). Maxon, S. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550(US)); Dalhed, S.; Hagelstein, P. L.; London, R. A.; MacGowan, B. J.; Rosen, M. D.; Charatis, G.; Busch, G. *Physical Review Letters (USA)*, 63(3): 236-239 (17 Jul 1989). DOE Contract W-7405-ENG-48.

Near-optimum conditions for lasing in Ni-like W are calculated for a 90-μg/cm^2 foil irradiated by a 2ω (λ=0.53 μm), 2.3$\times$10^{14}-W/cm^2, 550-ps trapezoidal pulse. The gain coefficient for the J=0–1, 4d-4p Ni-like transition at 43.1 A is predicted to be 5.5 cm^{-1}. The electron density and temperature are 2.5$\times$10^{21} cm^{-3} and 860 eV at x-ray laser time.

38978 Integrated injection-locked high-power cw diode laser arrays. Hohimer, J. P. (Sandia National Laboratories, Albuquerque, New Mexico 87185(US)); Myers, D. R.; Brennan, T. M.; Hammons, B. E. *Applied Physics Letters (USA)*, 55(6): 531-533 (7 Aug 1989). DOE Contract AC04-76DP00789.

We report the first integrated injection-locked high-power continuous-wave diode laser array with an on-chip independently controlled master laser. This device emits a near-diffraction-limited (0.5° full width at half maximum) single-lobed far-field emission beam at single-facet powers up to 125 mW. Also, by current tuning the emission wavelength of the master laser, we observe steering of the single-lobed emission over an angular range of 0.50° at a rate of -1.2×10^{-2} deg/mA. Our work demonstrates the feasibility of incorporating active optical injection and control in the structure of high-power diode laser devices.

38979 Generation of tunable near-infrared amplified femtosecond laser pulses and time-correlated white-light continuum. Olbright, G. R. (Sandia National Laboratories, Albuquerque, New Mexico 87185 (US)); Hadley, G. R. *Journal of the Optical Society of America B: Optical Physics (USA)*, 6(7): 1363-1369 (Jul 1989). DOE Contract AC04-76DP00789.

We report the generation of kilohertz-rate, amplified, sub-100-fsec-duration laser pulses tunable from 785 to 825 nm. A novel two-stage amplification scheme is used to produce amplified, tunable optical pulses, with microjoule energies. Diffraction-limited focusing of the amplified laser pulses in ethylene glycol to peak intensities greater than 10^{13} W/cm^2 results in the efficient generation of white-light continuum pulses with a bandwidth extending from 0.4 to 1.0 μm. This tunable laser system is well suited for sensitive femtosecond spectroscopic measurements in the near infrared, and its tunability may easily be extended to cover the wavelength range 600–900 nm.

38980 Optical gain and loss studies in Ce^{3+}:$YLiF_4$. Lim, K. (Department of Physics and Institute of Material Science, University of Connecticut, Storrs, Connecticut 06269-3046 (US)); Hamilton, D. S. *Journal of the Optical Society of America B: Optical Physics (USA)*, 6(7): 1401-1406 (Jul 1989).

Transient and stable color centers created by optical pumping at 308 nm have been studied in Ce^{3+}:$YLiF_4$. Since the color centers are absorptive at the cerium emission wavelengths, they degrade the Ce^{3+}:$YLiF_4$ laser performance. The color centers are produced following a multiphoton ionization of the Ce^{3+} ions. Rate equations that incorporate both creation and photobleaching processes are developed to model the observed kinetics and intensity dependence of the color-center density. Measurements of the single-pass gain at 325 nm as a function of the repetition rate of the pump laser are interpreted in terms of the relaxation time of the transient centers.

38981 Suppression of sidebands by diffraction in a free-electron laser. Antonsen, T. M., Jr. (Laboratory for Plasma Research, University of Maryland, College Park, Maryland 20742(US)); Laval, G. *Physics of Fluids B: Plasma Physics (USA)*, 1(8): 1721-1727 (Aug 1989).

The stability of sidebands in a free-electron laser is determined in the regime in which the three-dimensional structure of the modes is important. It is found that the growth rate of the sidebands in the presence of a fundamental mode that is weakly guided by the beam is reduced. The indications are that for some parameters the spatial growth rate of the sidebands can be made less than that of the fundamental.

38982 Far field propagation of the truncated EH_{11} dielectric waveguide mode. Bennett, C. A. (Oak Ridge National Laboratory, Physics Division Oak Ridge, Tennessee 37831-6372 (US)); Hutchinson, D. P. *Applied Optics (USA)*, 28(13): 2581-2583 (1 Jul 1989). DOE Contract AC05-84OR21400.

The Fraunhofer diffraction pattern from hole-coupled and nonhole-coupled waveguides is obtained in analytical form. Nonlinear regression is used to fit a Gaussian beam to the far field pattern, and the effective beam waist is computed and compared to previous measurements. The ratio of the effective beam waist and the output aperture radius is found to depend on the ratio of the aperture and waveguide diameters. The percentage of power contained in nonzero diffraction orders is computed.

38983 Cavity dumping for free electron lasers. Cutolo, A. (Stanford University, Photon Research Laboratory, Stanford, California 94305(US)); Benson, S. V.; Schultz, J. F.; Madey, J. M. *Applied Optics (USA)*, 28(15): 3177-3182 (1 Aug 1989).

The cavity dumping technique, applied to free electron lasers (FEL), is described. Taking advantage of both numerical simulations and experimental results on the Mark III FEL, a fairly exhaustive analysis is reported. In particular, we show that the output peak power can be increased by a factor even higher than one hundred. The cavity dumping experiment, under way on the Mark III FEL, is discussed in some detail.

4204 Heat Transfer and Fluid Flow

Refer also to citation(s) 37941, 38402, 39754

38984 (ANL/MCT–88/2) **Analysis of pressure drop and heat transfer data from the reversing flow test facility.** Roach, P.D.; Bell, K.J. Argonne National Lab., IL (USA). May 1989. 28p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract W-31109-ENG-38. Order Number DE89013907/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Reversing Flow Test Facility is part of the heat engine R and D capabilities at Argonne National Laboratory. The facility permits the study of heat transfer and pressure drop under conditions of rapidly reversing flow. This report summarizes the results that have been obtained to date from more than 100 data sets that cover a wide range of temperatures, pressures, and frequencies. Pressure drop data are presented as normalized pressure drop vs. the Reynolds number calculated from the amplitude of the oscillatory flow. Heat transfer data for the regenerators are presented as regenerator effectiveness vs. Reynolds number. Three significant conclusions are derived from our analysis of the data: (1) no frequency dependence is observed in either the pressure drop or the heat transfer data, (2) the measured pressure drops for the heater

and coolers are distinctly higher than those calculated from steady-flow correlations, and (3) the heat transfer coefficient in the heater is about 80 percent of that predicted by steady-flow correlations. The correlations presented here provide the basis for improving existing models. 4 refs., 20 figs., 3 tabs.

38985 (BNL–42658) **Void distribution in a shallow bubbling pool.** Cheng, Lap Y.; Ting, Lu. Brookhaven National Lab., Upton, NY (USA). 1989. 10p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890819–19: ASME/AIChE national heat transfer conference, Philadelphia, PA, USA, 6-9 Aug 1989). Order Number DE89014517/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

An analytical model based on the variational principle of minimum energy is derived to determine the steady-state two-phase mixture level and axial void distribution of a non-condensable gas that is introduced uniformly across the base of a shallow liquid pool. The model expresses pool void fraction and mixture level in terms of the Froude and Weber numbers, while the void fraction just below the free surface depends only on the Weber number. The shallow pool model is based on the assumption of one-dimensional flow of an inviscid bubbly mixture in a pool with its height much less than its diameter. It is also assumed that both the hydrostatic pressure of the pool and the pressure difference across the bubble surface are much smaller than the ambient pressure. By including the dependency of the added mass coefficient on void fraction, the model predicts a maximum bubbly flow void fraction of 0.3 which agrees well with the observed transition from bubbly to churn-turbulent flow at a void fraction between 0.2 and 0.3. When the theoretical results for an inviscid shallow pool are compared with available experimental data for void fraction in pools which are not shallow and hence the viscous and wall effects are not negligible, the model underestimates the data on pool fraction by about a factor of 5. Good agreement is obtained between the inviscid model and a drift flux correlation for pool void fraction when the viscosity of water is extrapolated to 1/10 of the value at room temperature. 14 refs., 7 figs.

38986 (CONF-890819–15) **Analysis of flow boiling of ammonia and R-114 in a matrix heat exchanger.** Panchal, C.B. Argonne National Lab., IL (USA). 1989. 28p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract W-31109-ENG-38. From ASME/AIChE national heat transfer conference; Philadelphia, PA, USA; 6-9 Aug 1989. Order Number DE89012427/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An analysis is carried out for flow boiling in a vertical matrix aluminum heat exchanger. The prediction model, developed for thin film evaporation in a previous study, is extended to include heat transfer in the slug-flow regime that exists at low mass qualities. Appropriate criteria is used to switch from slug-flow to thin-film annular-flow analysis. The two-phase-flow convective heat transfer enhancement for the slug-flow is correlated with inclusion of fluid Reynolds and Prandtl numbers in addition to commonly used Martinelli parameter. This approach reflects transient nature of heat transfer in the slug-flow regime. The thin-film annular-flow analysis developed in the previous study is refined with inclusion of a reliable two-phase friction factor correlation. The experimentally measured pressure drop is used to validate the friction factor correlation. The resulting prediction method is used to predict exit mass qualities for ammonia and R-114. The experimental analysis includes flow boiling of ammonia and R-114 in a vertical brazed-aluminum matrix heat exchanger. The test unit has straight perforated fins on the fluid side and extruded rectangular channels on the single-phase (water) heating-media side. Only two parameters are adjusted to validate the analytical prediction method, the constant in the friction factor correlation, and the constant in the slug-flow heat transfer correlation. The results show that the combination of slug-flow and thin-film annular-flow model gives better prediction of the overall performance of the matrix heat exchanger than a single model applied for the whole range of mass qualities. 36 refs., 8 figs., 1 tab.

38987 (DOE/ID/12772–1) **Evaluation of commercial enhanced tubes in pool boiling: Topical report.** Jung, C.; Bergles, A.E. Rensselaer Polytechnic Inst., Troy, NY (USA). Mar 1989. 135p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FC07-88ID12772. Order Number DE89009028/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

In support of a study of shellside boiling with enhanced tubes, a pool boiling apparatus was developed and used to test single tubes with various structured boiling surfaces in R-113. The basic design of the tube-bundle test section was carried out and certain critical design features were tested experimentally. Copper tubes, 3/4 in. o.d. and 4 in. long, were selected with 1/4 in. diameter cartridge heaters. Four thermocouples were inserted in 3/32 in. diameter, 2 in. long holes. The pool boiling characteristics of a plain tube agree well with previous tests. Wolverine Turbo-B tubes with small, medium, and large features performed identically for a heat flux greater than 20 kW/m^2. For lower heat flux, however, the Turbo-B S was slightly superior. In general, the Wolverine Turbo-B tubes had more favorable boiling characteristics than the single Wieland Gewa-T tube that was tested. The test procedure is deemed entirely adequate for screening enhanced tubes to see which ones should be used in the tube-bundle test section. Three different ways of mounting the tubes were tested in R-113 at 65°C and 5 bar gage pressure. As all three constructions sealed well, the simplest design is recommended in which a snap ring fixes the tube to the wall and an O-ring seals against the pressure. The general design features of the tube bundle test chamber are also presented. 14 refs.

38988 (DP-MS–88-217) **Subcooled boiling of downward flow in a vertical annulus.** Johnston, B.S. Savannah River Lab., Aiken, SC (USA). 1989. 21p. Sponsored by DOE Defense Programs. DOE Contract AC09-76SR00001. (CONF-890819–1: ASME/AIChE national heat transfer conference, Philadelphia, PA, USA, 6-9 Aug 1989). Order Number DE89005320/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Measurements of steady state pressure drop were made for the downward flow of water in a vertical annulus at low pressure. The inner wall was uniformly heated to allow subcooled boiling. The minimum in the test section demand curve was compared to the onset of significant void (OSV) at the exit of the annulus. As expected, OSV was found to serve as a conservative predictor for avoiding flow excursions. However, at low flow rates the demand curve minima were significantly different from those obtained for upward flow. Similarly, conditions for OSV in downward flow were not predicted by the correlation of Saha and Zuber. More data are needed to establish a general correlation for OSV in downward flow. 14 refs., 9 figs.

38989 (EUR–11936) **Explicit "ALE" finite element formulation for 3D transient dynamic fluid-structure interaction problems.** Donea, J.; Giuliani, S. Commission of the European Communities, Luxembourg (Luxembourg). 1989. 56p. Available from NTIS (US Sales Only), PC A04/MF A01.

Finite element models, implemented in the computed code EURDYN-3M, are presented for the prediction of the non-linear response of three-dimensional fluid-structure systems exposed to transient dynamic loading. An arbitrary Lagrangian-Eulerian kinematical description of the fluid domain is adopted in which the grid points can be displaced independently of the fluid motion. This formulation leads to an easy and accurate treatment of fluid-structure interfaces and permits significant fluid sloshing and swirling to occur without producing excessive distorsions of the computational mesh. Two numerical examples are presented to illustrate the potential of the proposed modelling procedures.

38990 (SAND–89-0326C) **Two mapping techniques for calculating radiative heat transfer with scattering.** Gu, W.C.A.; Murata, K.K. Sandia National Labs., Albuquerque, NM (USA). 1989. 23p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (CONF-890819–11: ASME/AIChE national heat transfer conference, Philadelphia, PA (USA), 6-9 Aug 1989). Order Number DE89010436/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The problem of radiative heat transfer through a gray, emitting, absorbing, and scattering medium with uniform optical properties is reduced to one without scattering through two techniques. One uses scaling laws, and the other uses a self-consistent effective gas temperature. The scaling laws are derived via the P_1 approximation to the radiative transfer equation and can be applied to multidimensional problems with nonisothermal media. The effective temperature method is presently restricted to isotropic scattering and isothermal media. Both methods are evaluated in the current

study as a function of scattering albedo, wall emissivity, and optical thickness for two different geometries, and two sets of wall and gas temperatures. The effects of scattering anisotropy are also assessed for the P_1 method. The numerical results show that for these cases the scaling method is reasonably accurate for optically thick media with a scattering albedo less than 0.8, and the effective temperature technique is reasonably accurate for optically thin media for all albedos. 10 refs., 8 figs., 2 tabs.

4205 Materials Testing

Refer also to citation(s) 38391, 38943

38991 (FhG-IzfP–870117-TW) **Non-contact ultrasonic tests by means of interferometry and capacitative sensors.** Paul, M. Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Saarbruecken (Germany, F.R.). Inst. fuer Zerstoerungsfreie Pruefverfahren. 5 May 1987. 83p. (In German). Available from Fraunhofer-Institut fuer Zerstoerungsfreie Pruefverfahren, Saarbruecken (Germany, F.R.).

Methods for non-contact tests with ultrasonics produced by lasers on glowing or radioactive components are dealt with here. In particular, a heterodyne interferometer is described for the wide band testing of normal ultrasonic deflections and is compared with other types of interferometers. Applications such as the determination of grain size in thin sheets and the absolute determination of the ultrasonic deflections achieved are demonstrated. By means of reconstruction of the signal beam by the application of optical phase conjugation, the 'etendue' (ability to collect light) was improved from $2.6x10^{-7}$ to about $1x10^{-2}$, so that the use of this type of interferometry is possible, even on rough surfaces. A capacitative sensor was used for the quantitative measurement of the characteristics of the ultrasonic field produced by a laser, as the sound deflection in these experiments lay below the sensitivity threshold of the interferometer. A simple optical process for testing acoustic surface waves is described. (orig./HP).

38992 (UCRL–53868-88) **Engineering research and development: Thrust area report FY 88.** Lafranchi, E. Lawrence Livermore National Lab., CA (USA). Jun 1988. 313p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89014320/JAW. Available from NTIS, PC A14/MF A01 - OSTI; GPO Dep.

This annual report describes the accomplishments of the Engineering Research Program for fiscal year 1988. Sixty-seven research and development projects are covered. For each project, goal(s), technical description, and an overview of future work are provided.

4208 Electronic Circuits and Devices

Refer also to citation(s) 38305, 38841, 38953, 38992

38993 (SAND–89-0249C) **Radiation response of optically-triggered GaAs thyristors.** Carson, R.F.; Hughes, R.C.; Zipperian, T.E.; Weaver, H.T.; Brennan, T.M.; Hammons, B.E.; Klem, J.F. Sandia National Labs., Albuquerque, NM (USA). 1989. 8p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890723–11: 26. annual conference on nuclear and space radiation effects, Marco Island, FL, USA, 24-28 Jul 1989). Order Number DE89014939/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Gallium arsenide optically-triggered thyristors that exhibit tolerance to high x-ray dose rates have been fabricated. These two-terminal epitaxial devices feature breakover voltages of 18 V to 38 V with no radiation. They trigger at less than 2 volts with only tenths of mW of laser light, but do not trigger at 2×10^9 Rad(Si)/s with a bias level as much as 40 to 60 percent of the zero-radiation breakover voltage. When these devices are bombarded with neutrons, the reduced carrier lifetimes results in a decreased sensitivity to triggering by light and ionizing radiation.

38994 (UCRL–101177) **Reflection mask technology for x-ray projection lithography.** Hawryluk, A.M.; Ceglio, N.M.; Gaines, D.P. Lawrence Livermore National Lab., CA (USA). Jun 1989. 12p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8906163–1: 33. international conference on electron, ion and photon beam technology, Monterey, CA (USA), Jun 1989). Order Number DE89014038/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We report the first demonstration of the fabrication and characterization of soft x-ray reflecting masks suitable for x-ray projection lithography. We have patterned efficient (R > 50%) normal incidence x-ray mirrors to produce reflecting masks with measured x-ray contrasts > 500:1 over a sufficiently wide spectral range. Calculations indicate that masks on silicon substrates are thermally stable for a production-type lithographic facility. 8 refs., 4 figs.

38995 Dual-transistor method to determine threshold-voltage shifts due to oxide-trapped charge and interface traps in metal-oxide-semiconductor devices. Fleetwood, D. M. (Sandia National Laboratories, Albuquerque, New Mexico 87185(US)). *Applied Physics Letters (USA)*, 55(5): 466-468 (31 Jul 1989). DOE Contract AC04-76DP00789.

A new technique is proposed to evaluate the radiation response of metal-oxide-semiconductor (MOS) transistors. The method requires that otherwise identical *n*- and *p*-channel transistors be irradiated under the same conditions. Using assumptions similar to those of widely accepted "single-transistor" methods, standard threshold-voltage and mobility measurements are combined to accurately estimate threshold-voltage shifts due to oxide-trapped charge and interface traps. This approach is verified for several MOS processes. The dual-transistor method can be applied to devices with much larger parasitic leakage, and at shorter times following a radiation pulse, than subthreshold current or charge-pumping techniques.

38996 A virtual phase CCD detector for synchrotron radiation applications. Rodricks, B. (Department of Physics, The University of Michigan, Ann Arbor, Michigan 48109(US)); Clarke, R.; Smither, R.; Fontaine, A. *Review of Scientific Instruments (USA)*, 60(8): 2586-2591 (Aug 1989).

A two-dimensional charge coupled device (CCD) detector, based on the Texas Instruments "virtual phase" CCD, has been developed for synchrotron radiation applications. Simultaneous near-edge and multilayer scattering experiments have been carried out with the detector on an energy-dispersive synchrotron beamline. The detector was used in an optical mode where the CCD element is coupled to a phosphor screen by a pair of focusing and demagnifying lenses. We report on the performance of the detector in this mode.

4209 Waste Processing Plants and Equipment

Refer also to citation(s) 38717, 38731

38997 (DOE/IR/05106–T114) **Energy conservation through computerized automation of a wastewater treatment plant: A study of wastewater treatment plant in Phoenix, Arizona.** Urban Consortium for Technology Initiatives (USA). Energy Task Force. Jan 1984. 103p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract FG02-78IR05106. Order Number DE89015423/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The wastewater treatment system in the City of Phoenix consists of two plants at 23rd Avenue and 91st Avenue and serves five neighboring cities. The present treatment capacity available to these participating cities is 157 MGD. The current total energy bill for the two plants is approximately $2 million annually. After the expiration of contract with the utility company in 1984, the new rates are likely to mount the energy bill to $4 million annually. The object of this project is to study the feasibility of developing an energy conservation program for computerized automatic operation of the wastewater treatment system. This involves a study of variables in the system, economic automatic operation of equipment to reduce peak demands and effect optimum use of electric energy on a 24-hour, 7-day basis. 7 figs., 14 tabs.

38998 (WCWWA–8710, pp. 115-118) **An overview of the installation code for digester gas systems.** Turnbull, J.F.E. (Canadian Gas Association, Toronto, ON, Canada). Western Canada Water and Wastewater Association, Calgary, AB (Canada). 1987. (CONF-8710478–: 39. annual convention of the Western Canada Water and Wastewater Association, Saskatoon, Canada,

21-23 Oct 1987;CE–02659). In *Proceedings of the 39th annual convention of the Western Canada Water and Wastewater Association.* Available from Western Canada Water and Wastewater Association, P.O. Box 6168, Postal Station A, Calgary, AB, Canada T2H 2L4; $20.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

For many years, digester gas has been utilized instead of being wasted in the facilities where that gas is manufactured. These facilities are predominantly wastewater treatment plants or water pollution control plants. With the increased need for control of water pollution there is an increased need for control of the digester gas utilization. Utilizing digester gas presents four main problems: it is flammable, it is toxic, it is a wet gas, and it is a corrosive gas. This corrosive nature indicates the need for an installation code specifically for digester gas systems. Canadian National Code CanI-B105-M81 was developed for this purpose. The implementation of this code in Ontario requires four further steps. A standard must be incorporated as an Ontario regulation, thus assigning ministerial jurisdiction; a deviation committee must be set up to review requests for deviations from the code; additional standards related to digester systems must be evaluated; and finally, test criteria for certification of equipment must be established.

4210 Combustion Systems

Refer also to citation(s) 37930, 38692

38999 (EC–E40-11/3-1988, pp. 157-172) **Modernization of the Quebec incinerator.** Aubin, H. (Communaute urbaine de Quebec, PQ, Canada); Labrie, D.; Hains, J. Environment Canada, Ottawa, ON (Canada). 1988. (In French). (CONF-8810394–: 10. Canadian waste management conference, Winnipeg, Canada, 25-27 Oct 1988;MICROLOG–89-01998). In *Proceedings of the 10th Canadian waste management conference.* Available from Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A municipal incinerator was constructed in Quebec City in 1974; since 1978, modifications have been undertaken in order to improve performance and reduce emissions. The incinerator plant is designed to process 907 tonnes of solid municipal waste per day and includes four furnaces with boilers for recuperating heat and generating steam. The steam is sold to a local paper company, and auxiliary heat can be provided to the boilers by combustion of fuel oil. Since 1974, the plant has been operating almost without interruption and over 5.3 million tonnes of steam have been sold, generated from over 2.7 million tonnes of waste. A history of the modifications is presented, leading to the present situation in which 3 of the 4 furnaces have been transformed and new emission control systems are in the process of being installed. The latest modifications to the furnaces are primarily a new design of pipes for injection of secondary air, and an extending of the water-cooled furnace walls up to the level of the main grill. The result has been a reduction in flow of excess air, leading to improved combustion and enabling the electrostatic filter system to operate more efficiently and within its limits. This improved efficiency also ensures a considerable reduction in particulate emissions. The thermal efficiency of the boilers has also increased and repair downtime has decreased. 5 figs., 3 tabs.

39000 (N–89-18664) **High-resolution liquid-crystal heat-transfer measurments on the end wall of a turbine passage with variations in Reynolds number.** Hippensteele, S.A.; Russell, L.M. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1988. 15p. (NASA-TM–100827;E–4004;NAS–1.15:100827;CONF-880724–: 25. American Society of Mechanical Engineers/American Institute of Chemical Engineers/American Nuclear Society national heat transfer conference, Houston, TX, USA, 24-27 Jul 1988). Available from NTIS, PC A03/MF A01.

Local heat-transfer coefficients were experimentally mapped on the end-wall surface of a three-times turbine vane passage in a static, single-row cascade operated with room-temperature inlet air over a range of Reynolds numbers. The test surface was a composite of commercially available materials: a Mylar sheet with a layer of cholesteric liquid crystals, which change color with temperature, and a heater made of a polyester sheet coated with vapor-deposited gold, which produces uniform heat flux. After the initial selection and calibration of the composite sheet, accurate, quantitative, and continuous heat-transfer coefficients were mapped over the end-wall surface. The local heat-transfer coefficients (expressed as nondimensional Stanton number) are presented for inlet Reynolds numbers (based on vane axial chord) from 0.83 x 10(5) to 3.97 x 10(5).

4240 Pollution Control Equipment

39001 (EC–E40-11/3-1988 pv) **Flakt experience with air pollution control systems.** Jackson, H. (Flakt Canada Ltd., Ottawa, ON, Canada). Environment Canada, Ottawa, ON (Canada). 1988. (CONF-8810394–: 10. Canadian waste management conference, Winnipeg, Canada, 25-27 Oct 1988;MICROLOG–89-01998). In *Proceedings of the 10th Canadian waste management conference.* Available from Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The incineration of hazardous, pathological and municipal waste with energy recovery is being more and more accepted in North America. Environmental concerns of uncontrolled emissions of acid gases, organics and chlorinated dioxins have been addressed by specific testing and evaluation programs worldwide. With over 150 gas cleaning trains at 90 municipal solid waste hazardous waste plants, consisting of dry or wet/dry reactors followed by a fabric filter or electrostatic precipitator and wet scrubbers at some locations, Flakt technology is widely used to control acid gas, particulate and organic emissions from the combustion of wastes. The unique Flakt designs achieve the high removal efficiencies required by ever-more restrictive environmental regulations. Results of acid gas removals range up to 98% for HC1 annd 95% for SO_2. Organic removals for the toxic chlorinated dioxins and furans approach 99.9% plus under most fabric filter temperatures. A description is presented of Flakt experience and technology around the world, with regard to control of acid gases, chlorinated dioxins and heavy metals from incineration processes. Some future applications are also discussed. 13 refs., 10 figs., 6 tabs.

39002 **Exhaust gas clean up process.** Walker, R.J. To Dept. of Energy, Washington, DC. USA Patent 4,820,391. 11 Apr 1989. Filed date 16 Jun 1988. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

A method of cleaning an exhaust gas containing particulates, SO_2 and NO_x includes prescrubbing with water to remove HCl and most of the particulates, scrubbing with an aqueous absorbent containing a metal chelate and dissolved sulfite salt to remove NO_x and SO_2. and regenerating the absorbent solution by controlled heating, electrodialysis and carbonate salt addition. The NO_x is removed as N_2 or nitrogen-sulfonate ions and the oxides of sulfur are removed as a valuable sulfate salt.

4250 Power Cycles

Refer also to citation(s) 38306, 38307, 38687

43 PARTICLE ACCELERATORS

Refer also to citation(s) 38843

39003 (CERN–89-01) **CAS CERN Accelerator School second advanced accelerator physics course. Proceedings.** Turner, S. (ed.). European Organization for Nuclear Research, Geneva (Switzerland). 20 Feb 1989. 277p. (CONF-8709295–: CERN accelerator school course on advanced accelerator physics, Berlin, Germany, F.R., 14-25 Sep 1987). Order Number DE89620099/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS.

The advanced course on general accelerator physics given in West Berlin closely followed that organised by the CERN Accelerator School at Oxford in September 1985 and whose proceedings were published as CERN Yellow Report 87-03 (1987). However, certain subjects were treated in a different way, improved or extended, while some new ones were introduced and it is all of these which are included in the present proceedings. The lectures include particle-photon interactions, high-brilliance lattices and single/multiple Touschek effect, while the seminars are on the major accelerators presently under construction or proposed for the near future, applications of synchrotron radiation, free-electron lasers, cosmic accelerators and crystal beams. Also included are errata, and addenda to some of the lectures, of CERN 87-03.

4301 Design, Development, and Operation

Refer also to citation(s) 39013, 39473

39004 (CONF-8905141–2) **Operational experience with compressed geometry acceleration tubes in the Oak Ridge 25URC tandem accelerator.** Jones, C.M.; Haynes, D.L.; Juras, R.C.; Meigs, M.J.; Ziegler, N.F. Oak Ridge National Lab., TN (USA). 1989. 14p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From 5. international conference on electrostatic accelerators and associated boosters; Strasbourg, France; 24-27 May 1989. Order Number DE89014071/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Installation of compressed geometry acceleration tubes and other associated modifications have increased the effective voltage capability of the Oak Ridge 25URC tandem accelerator by about 3 MV. Since mid-September 1988, the accelerator has been operated routinely at terminal potentials up to 24 MV and occasionally near 25 MV. In 3500 hours of full-column operation, including 1100 hours at potentials about 22 MV, no significant spark-included damage was observed. Some considerations related to further improvements in voltage performance are discussed. 7 refs., 5 figs.

39005 (JINR-R–7-88-696) **Use of heavy ion accelerators for the production of nuclear track membranes.** Flerov, G.N.; Apel', P.Yu.; Didyk, A.Yu.; Kuznetsov, V.I.; Oganesyan, R.Ts. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions. 1988. 12p. (In Russian). Order Number DE89631428/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to At. Ehnerg.

The class of problems related to the use of heavy ion accelerators for the production of nuclear track membranes, a new type of polymer micro- and ultrafiltration material, is considered. The problem of forming a porous structure with required parameters is analysed on the basis of the experience gained in the Laboratory of Nuclear Reactions, JINR, when developing the nuclear track membranes from polyethylene terephthalate. The relationship between technical parameters of membranes (thickness, diameter and density of pores, pore shape, straggling of pore size) and characteristics of ion beams used for irradiation of polyner films is shown. The most important physical and chemical phenomena accompanying the processes of track sensibilization and etching in polymers are discussed. A brief survey of the works on nuclear track membranes which are in progress in foreign scientific centres is given. The problem of elaboration of specialized multicharged-ion accelerators for applied investigations is considered. 27 refs.; 6 figs.

39006 (KIYI–88-3) **Measurement-analysis complex Express. 1. Tandem accelerator Cascade.** Zaikin, G.G.; Klyuchnikov, A.A.; Kozar', A.A. and others. AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. 25p. (In Russian). Order Number DE89631429/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A description of ion accelerator of tandem-type of horizontal accomplishment with maximum accelerating voltage equal to 1 MV, used for the solution of the elemental analysis of material is presented. The accelerator enables to accelerate the ions of hydrogen and helium. A description is given on a pronciple of operation and details of construction of some systems and accelerator devices: an injector of negative ions, acceleration systems, a high voltage supply, a vacuum system, a device of extraction and analysis of accelerated beam. Results of its experiments, are presented. An acceleration and extraction at a target of ions of hydrogen and helium at accelerating voltage up to 800 kV were carried out. 10 refs.; 5 figs.

39007 (LBL–25906) **Bevalac versatility: Operations achievements in the multi-tasking mode.** Lothrop, F.; Alonso, J.; Miller, R.; Tekawa, M. Lawrence Berkeley Lab., CA (USA). Mar 1989. 4p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890335–226: 13. particle accelerator conference, Chicago, IL, USA, 20-23 Mar 1989). Order Number DE89014910/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Demand for relativistic heavy ion beams at the Bevalac has increased dramatically in the past two years. To keep pace, the Bevalac make use of five injectors, precise guide field control, preset beam transport line tunes, nine nuclear science target areas, and three biology/radiotherapy areas, along with elegant control computer algorithms, to achieve high operating efficiency. Routine operation includes as many as ten ion/energy/beamline changes per day, 15 major nuclear science experiments each year, radiotherapy on nearly a daily basis, with biology experiments operating biweekly. High operating efficiency and low failure rates combine to produce high annual research hours. 12 refs., 2 figs.

39008 (SLAC-PUB–4963) **Real-time applications of neural nets.** Spencer, J.E. Stanford Linear Accelerator Center, Menlo Park, CA (USA). May 1989. 5p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-890545–6: 6. conference on real-time computer applications in nuclear, particle and plasma physics, Williamsburg, VA, USA, 15-18 May 1989). Order Number DE89014400/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Producing, accelerating and colliding very high power, low emittance beams for long periods is a formidable problem in real-time control. As energy has grown exponentially in time so has the complexity of the machines and their control systems. Similar growth rates have occurred in many areas, e.g., improved integrated circuits have been paid for with comparable increases in complexity. However, in this case, reliability, capability and cost have improved due to reduced size, high production and increased integration which allow various kinds of feedback. In contrast, most large complex systems (LCS) are perceived to lack such possibilities because only one copy is made. Neural nets, as a metaphor for LCS, suggest ways to circumvent such limitations. It is argued that they are logically equivalent to multi-loop feedback/forward control of faulty systems. While complimentary to AI, they mesh nicely with characteristics desired for real-time systems. Such issues are considered, examples given and possibilities discussed. 21 refs., 6 figs.

4302 Beam Dynamics, Field Calculations, and Ion Optics

Refer also to citation(s) 39429

39009 (BNL–42938) **A noniterative method for calculating beam position from induced electric signals.** Bozoki, E.S.; Huang, Jung-Yun; Bittner, J.W. Brookhaven National Lab., Upton, NY (USA). 1989. 4p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890335–231-Vugraphs: 13. particle accelerator conference, Chicago, IL, USA, 20-23 Mar 1989). Order Number DE89015094/JAW. Available from NTIS, PC A02/MF A01 - OSTI.

The PUE's in the NSLS storage rings are of the 4 button type. Near the center of the PUE the beam position can be well approximated with a linear function of the sum and the difference signals induced on these electrodes by the bunched beam. The nonlinear response of the PUE's further away from the center was measured. An algorithm was developed to compensate for this effect. 7 refs., 5 figs., 1 tab.

39010 (INIS-mf–11480, pp. 13-14) **Theory of nonlinear oscillations applied to particle trajectory calculations in accelerators.** Schnizer, B.; Moshammer, H.; Hagel, J. Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik.

Nov 1988. (In German). In *Annual report of the Institute for Theoretical Physics in Graz, Austria.* Order Number DE89631627/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

ACCELERATORS/beam dynamics; ACCELERATORS; ANALYTICAL SOLUTION; D CODES; NONLINEAR PROBLEMS; ORBIT STABILITY; PERTURBATION THEORY; PROGRESS REPORT; STORAGE RINGS

39011 (LBL–26862) **An x-ray microprobe using focussing optics with a synchrotron radiation source.** Thompson, A.C.; Underwood, J.H.; Wu, Y.; Giauque, R.D. Lawrence Berkeley Lab., CA (USA). Jan 1989. 15p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-8808141–13: 3. international conference on synchrotron radiation instrumentation, Tsukuba, Japan, 29 Aug - 2 sep 1988). Order Number DE89013425/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An x-ray microprobe can be used to produce maps of the concentration of elements in a sample. Synchrotron radiation provides x-ray beams with enough intensity and collimation to make possible elemental images with femtogram sensitivity. The use of focussing x-ray mirrors made from synthetic multilayers with a synchrotron x-ray beam allows beam spot sizes of less than 10 μm x 10 μm to be produced. Since minimal sample preparation is required and a vacuum environment is not necessary, there will be a wide variety of applications for such microprobes. 8 refs., 6 figs.

39012 **Laser driven plasma accelerators.** Chen, F.F. (Electrical Engineering Dept., Univ. of California, Los Angeles, CA (US)). v.v of High intensity laser-matter interactions. Campbell, E.M.; Baldis, H. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-8801117–: High intensity laser matter interactions, Los Angeles, CA, USA, 12-13 Jan 1988).

Linear particle accelerators can be made 100-1000 times shorter than conventional ones if the electric field of an electron plasma wave is used instead of that of a microwave cavity. Intense plasma waves can be excited by particle beams or laser beams. The most advanced concept, the Beat-wave Accelerator, has been studied extensively in theory, simulation, and experiment. Small-scale experiments have already demonstrated fields of order 1GeV/m, the existence of accelerated electrons, the effects of competing processes, and the nature of wave saturation. A proof-of-principle experiment employing a subnanosecond CO_2 laser is in progress.

39013 **The injection chicane of the National Bureau of Standards - Los Alamos Racetrack Microtron.** Debenham, P.H. (Radiation Source and Instrumentation Div., National Bureau of Standards, Gaithersburg, MD (US)); Bruce, S.S.; Penner, S.; Wilson, M.A.D. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science (USA),* 36(2): 1340-1343 (Apr 1989).

Injection of 5-MeV electrons into the Natinal Bureau of Standards-Los Alamos racetrack microtron is accomplished with a dipole magnet on the linac axis. A three-magnet chicane is used to compensate for the unwanted deflection of the recirculating beam by the injection magnet. In order to minimize emittance growth due to power supply noise, the three chicane magnets are driven by two power supplies, with each supply connected in series to two coils in different magnets. This arrangement, together with the tight space available for the chicane, constrains the choice of conductors and leads to very precise and compact low-field magnets. Magnetic field measurements demonstrate that all design goals have been achieved.

4303 Auxiliaries and Components

Refer also to citation(s) 39378

39014 (INIS-SU–87/A, pp. 11-13) **Monitoring complex for beam research on linear induction accelerators.** Vakhrushin, Yu.P. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)); Volzhev, A.A.; Demskij, M.I.; Trifonov, D.E. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). (CONF-8706388–: 10. All-Union seminar on linear accelerators, Kharkov, Ukrainian SSR, 2-4 Jun 1987). In *Physical experiment technique. Scientific-technical collection of papers.* Order Number DE89012157/JAW. Available from NTIS (US Sales Only), PC A05/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 4(35).

Equipment for monitoring main beam parameters - energy spectrum, beam emittance and beam profile is described. The analyser permits to measure electron energy spectrum up to 7 MeV. After each pulse the spectrum shape is recorded on the oscillograph screen. The current pulse duration for measuring prompt spectrum does not exceed 50 ns. The beam emittance monitoring device provides for measuring both within the whole beam current pulse and at separate time spans of 30 ns. The beam profile is displayed by picture monitor. 4 refs.; 3 figs.

39015 (INIS-SU–87/A, pp. 59-60) **High-voltage pulse generator with stable peak.** Taller, E.G. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.); Taran, G.V.; Khajlo, V.D.; Chernetskij, K.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). (CONF-8706388–: 10. All-Union seminar on linear accelerators, Kharkov, Ukrainian SSR, 2-4 Jun 1987). In *Physical experiment technique. Scientific-technical collection of papers.* Order Number DE89012157/JAW. Available from NTIS (US Sales Only), PC A05/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 4(35).

Results of development of high-voltage pulse generator designed for supply ion injector are presented. Ion injector parameters are as follows: voltage 15 kV, current up to 1.3 A pulse duration 500 μs, repetition rate 5 Hz, stabilty of pulse height under loading not worse than 1%. The circuit of the device comprising twenty-cascade capacitor-diode limiter and regulating tube, operating in the basic regime is studied. Diagrams for different regimes are presented. 5 refs.; 4 figs.

39016 (JINR-R–9-88-641) **Investigation of ion axial injection system for the U-200 cyclotron.** Bogomolov, S.L.; Vinogradov, Yu.B.; Gikal, B.N.; Gul'bekyan, G.G.; Efremov, A.A.; Kalchev, D.I.; Kutner, V.B.; Kolesov, I.V.; Oganesyan, R.Ts. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions. 1988. 11p. (In Russian). Order Number DE89631441/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to the Organizing committee of the 9. All-union meeting on charged particle accelerators, Dubna, October 1988.

The results of the startup of ion axial injection system for the U-200 cyclotron are presented. Efficiency of beam transmission from separating magnet to final accelerating radius is 8-10% without beam bunching. Utilization of bunching system permitted to increase the accelerated beam intensity by a factor of 2. The influence of space charge in the transport system with the beam intensity up to 1 mA (for A/Z=4) is considered. 18 refs.; 8 figs.; 3 tabs.

39017 (KEK–88-5, pp. 180-192) **Transient dosimetry with the aid of an electron linear accelerator.** Yamamoto, Takayoshi (Osaka Univ., Ibaraki (Japan). Inst. of Scientific and Industrial Research); Yamasaki, Akimitsu. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Jul 1988. (CONF-8802136–: 2. workshop on elementary-particle picture of the universe, Tsukuba, Japan, 4-6 Feb 1988). In *Radiation detectors and their uses.* Order Number DE89012160/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

When a single crystal of alkali halide is irradiated with high-energy electrons, the halogen ion X^- is ionized to be a hole X^0, which is at once combined with the neighboring (110) X^- and becomes a hole trap of the form X_2^- (V_k center). The X_2^- is in a metastable state. As the potential around X_2^- is similar to that of the hydrogen molecular ion, an electron in the conduction band is trapped to form a self-trapped exciton (STE). The STE is unstable because it exists on the top of the saddle-like potential formed by the surrounding alkali ions, and so it easily moves to the (110) direction while repeating collisions. It is finally combined with a halogen ion in the (110) direction and becomes X_4^{3-} (H-center). An electron is trapped where X^- is removed off, to form an F-center. Finally, a stable Frenkel pair is left. In alkali halide, both V_k-center and STE are very short-lived excitons at room temperature, the life

time being of the order of several hundreds picoseconds. As it is considered that the time variation of the growing density of excitons corresponds to the deposited energy mainly due to the secondary electrons to each point momently, it might be possible for information on short-lived color centers to be applicable to the dynamics of the radiation dosimetry. (N.K.).

39018 (KEK–88-7) **Proceedings of the symposium on negative ion sources and their applications.** Mori, Yoshiharu; Takagi, Akira (eds.). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Oct 1988. 187p. (CONF-8804288–: Symposium on negative ion sources and their applications, Tsukuba (Japan), 5-6 Apr 1988). Order Number DE89012159/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

Individual papers in these proceedings are separately indexed.

39019 (KEK–88-7, pp. 12-45) **Cusp-magnetic-field negative-heavy ion source.** Mori, Yoshiharu (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)); Takagi, Akira; Ueno, A.; Ikegami, K.; Rokugawa, Akio; Fukumoto, S. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Oct 1988. (CONF-8804288–: Symposium on negative ion sources and their applications, Tsukuba, Japan, 5-6 Apr 1988). In *Proceedings of the symposium on negative ion sources and their applications.* Order Number DE89012159/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

Performance the characteristics of the cusp-magnetic-field negative-heavy ion source which has been recently developed at National Laboratory for High Energy Physics (KEK) are described. This ion source has generated the various negative-heavy ions with the beam intensities of more than 50-100 times larger than the ordinary sputtered negative ion source. (auhtor).

39020 (KEK–88-7, pp. 1-11) **Fundamental processes of heavy negative ion production and beam transportation.** Ishikawa, Junzo (Kyoto Univ. (Japan). Faculty of Engineering). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Oct 1988. (CONF-8804288–: Symposium on negative ion sources and their applications, Tsukuba, Japan, 5-6 Apr 1988). In *Proceedings of the symposium on negative ion sources and their applications.* Order Number DE89012159/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

The report briefly outlines the fundamental processes of heavy negative ion production and beam transportation. A heavy negative ion source recently developed is also described. Negative ion production efficiency is relatively high when an atom leaves a metal surface with a higher velocity than the thermal velocity. This phenomenon, called the secondary negative ion emission, is used in sputter-type heavy nagative ion sources. Cesium has the lowest work function among all elements. The work function of a cesium-covered surface is generally lower than that of bulk cesium. In a sputtertype heavy negative ion source, cesium atoms are continuously supplied onto the sputtering target as neutral particles and/or a cesium ion beam. At the same time, cesium atoms on the sputtering target are sputtered by cesium or heavy positive ion bombardment. Major requirements for a high current heavy negative ion production include control of target temperature, additional neutral cesium supply, high ion current for bombardment, and high incident angle of bombardment ion beam. A neutral and ionized alkaline metal bombardment type heavy negative ion source has been developed taking these requirements into account. It consists of a cesium plasma ion source, suppressor, target electrode, negative ion extraction electrode and einzel lens. (N.K.).

39021 (KEK–88-7, pp. 106-120) **Present status of the negative ion sources and injectors at JAERI tandem accelerator facility.** Minehara, E. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment); Yoshida, T.; Abe, S. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Oct 1988. (CONF-8804288–: Symposium on negative ion sources and their applications, Tsukuba, Japan, 5-6 Apr 1988). In *Proceedings of the symposium on negative ion sources and their applications.* Order Number DE89012159/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

The JAERI tandem accelerator began regular operation with the 350 kV negative ion jnjector and 3 kinds of nagative ion sources (Direct Extraction Duoplasmatron Ion Source, Heinickie Penning Ion Source, Negative Ion Sputter Source (Refocus-UNIS)) since 1982. An extension with the injector was constructed in 1984, (1) to increase reliability of all devices in the injector, (2) to exclude completely any unsafe operation in the injector, and (3) to tune several ion sources simultaneously, while a certain ion source is in operation. After the extended injector became available, we have been able to run the whole injector system very safely, steadily and effectively, and have had few troubles. Currently, the second injector has been constructed in order to obtain a full strength of resistance against any sudden troubles in the injector. Several other operational and developmental items will be discussed in the text briefly.

39022 (KEK–88-7, pp. 121-128) **High melting point materials for PIG ion source and their related problems.** Itahashi, T. (Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Oct 1988. (CONF-8804288–: Symposium on negative ion sources and their applications, Tsukuba, Japan, 5-6 Apr 1988). In *Proceedings of the symposium on negative ion sources and their applications.* Order Number DE89012159/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

Several materials and structures for PIG ion source have been studied to get the better performances for highly stripped ions. Among arc characteristics measured with high melting point materials, tungsten cathode has been operated in the highest arc voltage although it has the higher wear rate than the other materials as niobium, tantalum and molybdenum alloy (TZM). These arc voltages are closely related to the work functions of each cathode materials. In their cathode structures, well cathode cooling can be operated with a higher impedance that the poor cathode cooling. Simultaneously, the cathode temperature has been measured for these materials and tungsten cathode has become the maximum temperature among these due to its operation with the highest arc voltage. Moreover, accelerator mass spectrometry was proposed to analyse the composition involved in these materials for electrodes of PIG source.

39023 (LA–11638-PR) **The Manuel Lujan, Jr. Neutron Scattering Center LANSCE experiment reports 1988 run cycle: Progress report.** Hyer, D.K. (comp.). Los Alamos National Lab., NM (USA). Jun 1989. 93p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-36. Order Number DE89014392/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This year was the first in which LANSCE ran a formal user program, which is patterned after the one that exists at the Institut Laue- Langevin, Grenoble, France. A call for proposals is issued before each scheduled run cycle, and experiment proposals are submitted by scientists from universities, industry, and other research facilities around the world. An external program advisory committee, which LANSCE shares with the Intense Pulsed Neutron Source (IPNS), Argonne National Laboratory, examines the proposals and makes recommendations. Joint meetings are held where proposals for the two centers are examined at the same time. Operational issues prevented such a joint meeting in 1988, but one was scheduled prior to the 1989 run cycle. At LANSCE neutrons are produced by spallation when a pulsed, 800-MeV proton beam impinges on a tungsten target. The proton pulses are provided by the Los Alamos Meson Physics Facility (LAMPF) accelerator and an associated Proton Storage Ring (PSR), which can alter the intensity, time structure, and repetition rate of the pulses. The LAMPF protons of Line D are shared between the LANSCE target and the Weapons Neutron Research facility, which results in LANSCE spectrometers being available to external users for unclassified research about 60% of each six-month LAMPF run cycle. Classified measurements of interest to the Los Alamos National Laboratory may also be performed and may occupy up to 20% of the available beam time. These experiments are reviewed by an internal program advisory committee. One hundred two proposals were submitted for unclassified research and 12 proposals for research of a programmatic nature to the Laboratory. Oversubscription for instrument beam time by a factor of two was evident with 459 total days requested and only 242 available for allocation.

39024 (LBL–25916) **Laced permanent magnet quadrupole drift tube magnets.** Feinberg, B.; Behrsing, G.U.; Halbach, K.;

Marks, J.S.; Morrison, M.E.; Nelson, D.H. Lawrence Berkeley Lab., CA (USA). Mar 1989. 3p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890335–229: 13. particle accelerator conference, Chicago, IL, USA, 20-23 Mar 1989). Order Number DE89015446/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Twenty-three laced permanent magnet quadrupole drift tube magnets have been constructed, tested, and installed in the SuperHILAC heavy ion linear accelerator at LBL, marking the first accelerator use of this new type of quadrupole. The magnets consist of conventional tape-wound quadrupole electromagnets, using iron pole-pieces, with permanent magnet material (samarium cobalt) inserted between the poles to reduce the effects of saturation. The iron is preloaded with magnetic flux generated by the permanent magnet material, resulting in an asymmetrical saturation curve. Since the polarity of the individual quadrupole magnets in a drift tube linac is never reversed, we can take advantage of this asymmetrical saturation to provide about 20% greater focusing strength than is available with conventional quadrupoles, while replacing the vanadium permendur poletips with iron poletips. Comparisons between these magnets and conventional tape-wound quadrupoles will be presented. 3 refs., 5 figs.

39025 (LBL–25930) **Charge state distributions for heavy ions in carbon stripper foils.** McMahan, M.A.; Lebed, R.F.; Feinberg, B. Lawrence Berkeley Lab., CA (USA). Mar 1989. 4p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890335–225: 13. particle accelerator conference, Chicago, IL, USA, 20-23 Mar 1989). Order Number DE89014911/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We have extended the database of measured charge state distributions available in the literature through measurements at the SuperHILAC using carbon stripper foils in the energy range 1.2–8.5 MeV/u. Modifying a semi-empirical model to include the effect of electronic shells, we are able to correctly predict the mean charge state to within 1/2 a charge state for $6 \leq Z \leq 92$ and energies from 30 keV/u to 16 MeV/u. We have determined parameters for the widths of the distributions for each electronic shell. For distributions lying across a shell boundary, we join the two Gaussians of different widths to get an asymmetric distribution. 18 refs., 4 figs., 2 tabs.

39026 (LBL–25931) **Operational results for the raster scanning power supply system constructed at the Bevalac Biomedical Facility.** Stover, G.; Halliwell, J.; Nyman, M.; Dwinell, R. Lawrence Berkeley Lab., CA (USA). Mar 1989. 3p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890335–224: 13. particle accelerator conference, Chicago, IL, USA, 20-23 Mar 1989). Order Number DE89014908/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A raster scanning power supply for controlling an 8.0 Tesla-meter relativistic heavy-ion beam at the Biomedical Facility has been recently completed and is undergoing electrical testing before on- line operation in 1989. The scanner system will provide tightly controlled beam uniformity and off-axis treatment profiles with large aspect ratios and unusual dimensions. This article will discuss original specifications, agreement with measured results and special device performance (i.e. GTOs, FET actuator assembly, etc.). 5 refs., 4 figs.

39027 (SLAC-PUB–4890) **The SLAC linac as used in the SLC collider.** Seeman, J.T.; Abrams, G.; Adolphsen, C.; Atwood, W.; Bane, K.L.F.; Iverson, R.; Jacobsen, R.; Himel, T.M.; Jobe, R.K.; Lavine, T.L. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jun 1989. 4p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00515;AC03-81ER40050;AC03-76SF00098;AM03- (CONF-890335–227: 13. particle accelerator conference, Chicago, IL, USA, 20-23 Mar 1989). Order Number DE89014395/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The linac of the SLAC Linear Collider (SLC) must accelerate three high intensity bunches on each linac pulse from 1.2 GeV to 50 GeV with minimal increase of the small transverse emittance. The procedures and adjustments used to obtain this goal are outlined. Some of the accelerator parameters and components which interact are the beam energy, transverse position, component alignment, RF manipulation, feedback systems, quadrupole lattice, BNS damping, energy spectra, phase space matching, collimation, instrumentation and modelling. The method to bring these interdependent parameters collectively into specification has evolved over several years. This review is ordered in the sequence which is used to turn on the linac from a cold start and produce acceptable beams for the final focus and collisions. Approximate time estimates for the various activities are given. 21 refs.

39028 (UCRL–97820) **Design considerations for a stored energy electron beam absorber.** Walter, C.E.; Hedtke, R.R.; Doll, D.W. Lawrence Livermore National Lab., CA (USA). May 1989. 9p. Sponsored by Department of Defense. DOE Contract W-7405-ENG-48. (CONF-890815–12: 24. intersociety energy conversion engineering conference, Washington, DC (USA), 7-12 Aug 1989). Order Number DE89013776/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Applications for high-average-power electron accelerators, such as the ground-based free-electron laser, place stringent requirements on the design of the electron beam absorber. The attendant duty cycles for these accelerator systems are such, however, that energy storage absorber devices may be considered. Preliminary design characteristics of a rotating electron-beam absorber made of graphite, which operates in a stored energy mode, have been developed. The thermophysical and mechanical properties of graphite make it a suitable material for this application. Several features are incorporated in the design to minimize radiation levels from operation. 13 refs., 8 figs., 1 tab.

4304 Storage Rings

Refer also to citation(s) 38956

39029 (DOE/FTR–9015462) **15th meeting of the HERA Machine Committee, Hamburg, West Germany, February 11–16, 1989: Foreign trip report.** Reardon, P.J. Brookhaven National Lab., Upton, NY (USA). 26 Jun 1989. 7p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH00016. Order Number DE89015462/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler attended the 15th Meeting of the HERA Machine Committee that was held on February 14–15, 1989 at DESY Laboratory in Hamburg, West Germany. This meeting consisted of discussions and general progress report. Some of the topics covered were: General progress report on E-Ring, progress report of P-ring, LINAC III, DESY III, aspects of Radiation Safety, Wideband Multibunch Feedback Systems for HERA, Diagnostic for the P-Ring, Measurement of SC Magnets.

39030 (SLAC-PUB–4998) **Status of PEP and TPC/2γ.** Zapalac, G. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jun 1989. 3p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8904226–4: 12. international workshop on weak interactions and neutrinos, Ginosar, Israel, 9-14 Apr 1989). Order Number DE89013896/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The TPC/2γ program at PEP has been upgraded by increasing the PEP luminosity and by the adding of a vertex chamber to the TPC detector. These improvements will allow a strong program in B and τ physics, and will contribute to ongoing studies in two-photon physics and hadronization. 10 refs., 3 figs.

44 INSTRUMENTATION

4401 Radiation Instrumentation

Refer also to citation(s) 38152, 38416, 38846, 39017, 39030, 39137, 39138, 39362, 39418, 39426, 39427, 39473, 39489, 39492, 39503, 39545, 39566

39031 (CEA-CONF–9636) **Very high plasma switches. Basic plasma physics and switch technology.** Doucet, H.J.; Roche, M.;

Buzzi, J.M. CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France); CEA Centre d'Etudes de Valduc, 21 - Is-sur-Tille (France). 1988. 25p. (CONF-8806385–: 14. International congress on electric contacts, Paris, France, 20-24 Jun 1988). Order Number DE89789220/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A review of some high power switches recently developed for very high power technology is made with a special attention to the aspects of plasma physics involved in the mechanisms, which determine the limits of the possible switching parameters.

39032 (CONF-890545–7) **Data acquisition for FNAL E665.** Geesaman, D.F.; Green, M.C.; Kaufman, S.; Tentindo-Repond, S.; Bartlett, J.F.; Melanson, H.L.; Petravick, D.; Michael, D.G.; McLeod, D.; Vidal, M. Argonne National Lab., IL (USA); Fermi National Accelerator Lab., Batavia, IL (USA). 1989. 6p. Sponsored by DOE/ER;OGA. DOE Contract W-31109-ENG-38;AC02-76CH03000. PHY88-11164. From 6. conference on real-time computer applications in nuclear, particle and plasma physics; Williamsburg, VA (USA); 15-18 May 1989. Order Number DE89015697/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The data acquisition system for FNAL E665, an experiment to study deep inelastic muon scattering from nucleons and nuclei, is described. The system is built with the FNAL VAXONLINE and RSX DA building blocks. The structure, capabilities and limitations for data flow, control and monitoring are discussed. 20 refs., 1 fig.

39033 (CONF-8806235–8) **The central tracking detectors for Dv.** Clark, A.; Goozen, F.; Klopfenstein, C.; Kerth, L.T.; Loken, S.; Strovink, M.; Trippe, T.G.; Bantly, J.; Buchholz, D.; Claes, D. Lawrence Berkeley Lab., CA (USA). 1988. 24p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098;AC02-80ER10699;AC02-76ER02289. From International conference on advanced technology and particle physics; Como (Italy); 12-17 Jun 1988. Order Number DE89015715/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Three types of drift chambers are being constructed for the Fermilab Dv experiment. The construction and readout of these chambers stress good spatial resolution, good two hit separation, and dE/dx. A 106 MHz FADC system with hardware zero suppression is being constructed to readout this system. 8 refs., 12 figs., 1 tab.

39034 (DOE/ER/40372–T2) **Liquids-in-capillaries: New fiber detectors for high energy physics applications.** Baumbaugh, B.; Bose, A.; Ditmire, T.; Kennedy, C.; Puseljic, D.; Ruchti, R.; Ryan, J.; Baumbaugh, A.; Knickerbocker, K.; Ellis, J. Notre Dame Univ., IN (USA). Dept. of Physics; Fermi National Accelerator Lab., Batavia, IL (USA). 1988. 8p. Sponsored by DOE Energy Research. DOE Contract AC02-87ER40372;AC02-76CH03000. (UND-HEP–3-24-89;CONF-8811199–3-App.II: Workshop on scintillating fiber detector development for the SSC, Batavia, IL, USA, 14-16 Nov 1988). Order Number DE89013679/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We are developing scintillating-fiber detectors incorporating organic liquid scintillation cocktails in glass capillaries. The organic solvents have high refractive index, making them suitable as core materials for scintillation waveguides. Only one fluorescent dye at high concentration (1%) is utilized in the solution. This ensures that the dominant energy transfer between solvent and solute will be nonradiative, and that fluorescent emission from the dye will be local to the ionization deposition in the material. Hence such structures might be suitable for high resolution tracking devices. Liquid scintillation solutions may also provide advantages in radiation resistance and replaceability. 8 refs., 6 tabs.

39035 (INIS-mf–11440, pp. 63-64) **Program for ESR-spectra acquisition and processing with HC-85 personal computer.** Georgescu, E. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering); Georgescu, R.; Valeanu, V. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The program allows ESR spectra acquisition, display during acquisition and processing, calibration in magnetic field, computation of spectral parameters and comparison with reference spectra. (authors).

39036 (INIS-mf–11440, pp. 57-58) **Calibration of gamma-ray spectrometers for radioactivity measurements of volumic samples.** Dumitrescu, R. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering); Legrand, I.; Sahagia, M.; Ferdes, O.; Vlad, E. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

A method for calibration gamma-ray spectrometers using volumic standard sources obtained from Am-241, Ba-133, Cs-134, Cs-37, and Eu-152 reference solutions is presented. (authors).

39037 (INIS-mf–11440, pp. 649) **Analysis of low-level radioactivity using the Bayesian statistics.** Popa, L. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering); Stere, G. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The analysis of low-level or dominant background dominant radioactiviy is complicated by the fact that sample net rate of activity above background may be negative, because of random fluctuations. (authors).

39038 (INIS-mf–11440, pp. 654-655) **Correlation between gross-beta and gamma spectrometry activities for the environmental samples.** Sonoc, S. (Institutul de Meteorologie si Hidrologie, Bucharest, Romania); Cuculeanu, V. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The number of beta particles emitted by the aerosol and deposition samples colected during May 1986 is compared with the number of pulses recorded by G.M. counter. (authors).

39039 (INIS-mf–11457(v.1,2) v. 1) **Development, introduction and early operating experience of a large scale external gamma monitoring program in Canadian uranium mines.** Bradley, R.P. (Department of National Health and Welfare, Ottawa, ON (Canada). Health Protection Branch); Grogan, D.; Kelemen, L. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

At a meeting of representatives of the Canadian Atomic Energy Control Board, uranium mining company managements, mine employee organizations, provincial ministries of Health and Labour and the Department of Health and Welfare (NHW), in August 1979, it was agreed that the Radiation Protection Bureau (RPB) of NHW would undertake to develop a dosimetry system for the assessment of exposures to uranium mine personnel from external gamma ray sources. This paper is divided into five sections: Conceptualization and problem definition; Development, Implementation, 'Shake-down' and Routine Operation. Each section adresses the problems encountered and solutions devised during the various phases of the development. Problems in dosimeter design, holder construction and distribution logistics are explained along with the chosen solutions. Finally, impressions of potential areas for further refinements as the system settles down to routine operation are presented.

39040 (INIS-mf–11457(v.1,2) v. 1) **Measurement of temporal variations in radon progeny working levels in mine atmospheres.** Roze, V. (alphaNUCLEAR, Mississauga, ON (Canada)); Raz, R.; Bigu, J. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order

Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

A radiation monitoring system based on a portable microcomputer is described which measures radon progeny Working Levels as a function of time. Polynomial filtering is used to unfold the time-integrated WL data and allow short-term fluctuations to be observed, as well as correcting for the time lag inherent in integrating monitors. The system can be used to monitor work sites for ambient radiation levels; personal monitoring is also possible because of the compact and rugged design. The applications and benefits of the system are described together with test data and a description of the mathematics and theoretical basis.

39041 (INIS-mf–11457(v.1,2) v. 1) **Aerodynamic parameter determination in inlet orifice of CEA alpha dosimeter.** Yoshida, K. (Saskatchewan Univ., Saskatoon, SK (Canada)). Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Among the aerodynamic parameters critically affecting the efficiency of personal alpha dosimeters, intended for use in the open-pit mining of uranium, the geometry of the sampling head and the size and location of the aspiration zone in relation to the breathing zone of the worker were examined in the laboratory. The size of aspiration zone of a CEA dosimeter, worn at the waist, was not large enough to overlap with the breathing zone. A discrepancy of radioactivity count in the aspiration zone and breathing zone (true value) would create some problems in efficiency determination.

39042 (INIS-mf–11457(v.1,2) v. 1) **Development of Track Etch dosimeters for measuring radon daughter exposures.** Gingrich, J.E. (Terradex Corp., Walnut Creek, CA (USA)); Oswald, R.A.; Alter, H.W. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Significant progress has been made recently in developing a completely passive, integrating radon daughter dosimeter suitable for personnel monitoring in uranium and other mines. This dosimeter concept is based on the Track Etch method for alpha particle detection. Tests in radon test chambers and uranium mines with these types of dosimeters have shown that they can produce results comparable with the currently used grab-sample radon daughter detection methods. In most instances the Track Etch dosimeters provide radon daughter exposures that are accurate to within ±20%. The encouraging results from these tests suggest that this dosimeter design offers significant advantages over the current methods for determining personnel radon daughter exposures of uranium and other mine and mill workers.

39043 (INIS-mf–11457(v.1,2) v. 1) **Development and field testing of the thermoluminescent personal α-dosimeter for measuring exposure to radon and thoron daughters.** Hongquan, L. (Research Inst. of Uranium Mining, Hengyang City, HN (Cote d'Ivoire)); Quangen, P.; Jianliang, Z. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

An active thermoluminescent personal alpha dosimeter for measuring exposure to radon and thoron daughters has been developed. The TL-chips mounted in the dosimeters are ultra-thin $CaSO_4$.Tm chips which are more sensitive to alpha radiation than those used in the other radon daughter dosimeters. The response of the chip to gamma radiation is decreased to such a level as 0.8 counts/mR, so the lower detection limit is reduced to 1.04 $\mu Jm^{-3}h$ (0.05 WLH) (γ background 1 mR/h; sampling period 6 hrs). Exposures to radon daughters and to thoron daughters can be determined separately by mounting three of those chips in the sampling probe of the dosimeter. The compact sampling pump, without flow regulator, features a satisfactory flow-resistance characteristics. The prototype units have been subjected to a series of tests in laboratory and fields since 1981. Testing results are summarized in the paper.

39044 (INIS-mf–11457(v.1,2) v. 1) **Long term measurements of WL-levels in metal mines by using the ASS-system and HCS-system.** Domanski, T. (Inst. of Occupational Medicine, Lodz (Poland)); Chruscielewski, W.; Wojda, A. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The long term measurements of WLs made in Polish non-uranium mines by means of the Air Sampling System /ASS/and the Helmet Cassette System /HCS/are presented. The HCS is based on track etch detectors, while ASS is based on portable instant WL-meters. Both systems were operating paralelly for two years. The technical compatability of measurement methods was tested and proved before experiment. It was found that in the majority of mines the ASS shows the higher concentrations than the HCS approximately about 2,5 times, but in some particular mines even 5 - 11 times. The reasons and possible implications are discussed.

39045 (INIS-mf–11457(v.1,2) v. 1) **Comparative tests of radon- and radon daughter detection systems under simulated environmental conditions.** Steinhausler, F. (Salzburg Univ. (Austria). Inst. fuer Allgemeine Biologie, Biochemie und Biophysik); Daschil, F.; Pfligersdorffer, P. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Radon- and radon daughter-monitors have to be able to function even in hostile environments, such as mining and milling operations. These conditions can range from high temperature/low humidity to low temperature/high humidity. Besides withstanding these environmental stresses the instrument response should be specific in case of the simultaneous presence of radon 222 and radon 220 (thoron) in the atmosphere, since the latter can represent a major component of the total occupational exposure. Commercially available instrumentation can be categorized as either basically monitoring radon gas and/or radon daughter products. Therefore in this study two such instruments were selected for the tests: an EDA-RDA-200 radon monitor and PYLON-WL-1000C radon daughter analyzer. These instruments were exposed to the extreme environmental conditions described above by using a dual-walk-in test chamber system. In these chambers temperature, relative humidity, radon-, and thoron- and decay product concentration were kept at preset defined levels. The operating characteristics of both instruments were studied with respect to reproducibility and reliability.

39046 (INIS-mf–11457(v.1,2) v. 1) **Calibration of the airborne radon daughter detector.** Annanmaki, M. (Institute of Radiation Protection, Helsinki (Finland)). Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

This paper describes four different methods of determining the efficiency of a radon daughter detector. The detector to be calibrated is based on silver activated zinc sulphide. One calibration method is the conventional method of using a calibrated Am-241 source. Three methods use calibrated reference instruments: a Ge-gammaspectrometer, an alphaspectrometer and a liquid scintillation counter. The determination of the efficiency of a radon daughter detector which has an aluminum-foil on the zinc sulphide is also presented.

39047 (INIS-mf–11457(v.1,2) v. 1) **In-mine evaluation of continuous radon and working-level detectors.** Briggs, M.R. (Colorado School of Mines, Golden (USA). Dept. of Mining); King, R.H.; Franklin, J.C. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

A continuous radiation monitoring system developed by the U.S. Bureau of Mines was installed in a Western underground uranium mine. Tests were run to compare data from current radiation sampling procedures with that from the continuous system. Results from the tests show that the continuous data mirrors trends in the Kusnetz data. Overall, the two systems seem to be fairly compatible, but more experimentation is recommended.

39048 (INIS-mf–11457(v.1,2) v. 1) **Local static method for measuring radon emanation rate from porous material.** Zhang Zhe (Uranium Mining Research Institute, Hengyang, HN (Cote d'Ivoire)). Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

This paper mainly discusses a new idea about calculation formula of local static method as which is used to measure radon emanation rate from porous material, so as to be in keeping with practice. New formula given in this paper has considered four factors affecting radon building up in collecting space during measurement: emanation, reverse diffusion into porous material, leakage and radioactive decay. Equi-interval sampling method has been found out to make new formula easier to use. Experiment results indicate that the new formula tallies with practice much better than primary formula does.

39049 (INIS-mf–11457(v.1,2) v. 2) **Measurement of radon and decay products in non uranium mines of the Federal Republic of Germany using active and passive methods.** Kompa, R. (Inst. for Radiation Hygiene, Federal Health Office of the Federal Republic of Germany); Pensko, J.; Schmier, H. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

A survey on the radiation exposure by radon and its short-lived decay products in different non-uranium mines of the Federal Republic of Germany has been conducted. The variation of the values obtained in continuous measurements of the decay product concentration within the mines is well correlated with the influence of ventilation. The calculated equilibrium factors range from 0.3 to 0.8. In two out of 15 mines under study the exposure limit of 5 WLM/a for uranium miners as recommended in ICRP [International Committee Radiological Protection] Publication 32 (1) is exceeded. In both cases simple measures would suffice to reduce the radon daughter product concentration.

39050 (INIS-mf–11457(v.1,2) v. 2) **Monitoring of radiation exposure from different natural sources in Polish coal mines.** Lebecka, J. (Central Mining Inst. Katowice (Poland)); Tomza, I.; Skubacz, K.; Chalupnik, S.; Skowronek, J. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The main subject of research work in Polish coal mines are the instrumentation and results of measurements of radon-daughters, radium-bearing waters and radioactive deposits. An integrating WL-monitor with TLD-chips designed as a supplement to the commercial dust sampler has been developed. A method of calibration of WL-monitors by means of liquid scintillation counting has been described. Radon-daughters concentration in mine workings did not exceed 13 $\mu J/m^3$. The deposits precipitated from radium-bearing waters contained up to 170kBq/kg of radium isotopes. In most of the investigated workplaces the radiation exposure does not exceed the limit recommended by ICRP for occupational exposure.

39051 (INIS-mf–11457(v.1,2) v. 2) **Transient response of radon and thoron chambers.** Pogorski, S. (Toronto Univ., ON (Canada). Dept. of Chemical Engineering and Applied Chemistry); Phillips, C.R. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

A transient model was developed to evaluate the time-dependent response of a radon/thoron chamber. Such a model has important applications when the atmosphere in the chamber is initially set up of varied for the purpose of calibrating and testing instruments or dosimeters. The experimental data collected show that a theoretical model can be used to predict the time-dependent radon gas and airborne radon daughter concentrations in a radon chamber. For the flow conditions used in the chamber, the unattached deposition velocity was estimated to lie between 0.07 and 0.15 cm s^{-1}, and the attached deposition velocity to be less than 0.002 cm s^{-1}. A sensitivity analysis of the theoretical model indicated that for a room of surface area to volume ratio less that 1:25 cm^2/cm^3, RaB and RaC values predicted by the theoretical model are relatively insensitive to the wall detachment probability chosen for recoiling RaB. The theoretical model was also used to show that radon daughter concentrations are most affected by changes in aerosol concentration when the aerosol concentration is low (between 1,000 to 10,000 particles/cc). The spatial concentration distribution in the chamber was measured and, although the variance was larger than can be explained by the inherent variance of the measurement technique, it was not large enough to warrant the inclusion of spatial parameters in the model.

39052 (INIS-mf–11457(v.1,2) v. 2) **Experiences with a passive integrating radon dosemeter combining activated charcoal and TLD.** Stranden, E. (National Inst. of Radiation Hygiene, Osteras (Norway)); Kolstad, A.K.; Lind, B. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

A passive integrating radon dosemeter combining activated charcoal and TLD is described. The dosemeter has been tested both in room atmosphere and in mining environments. Some survey programs utilizing the dosemeter are outlined.

39053 (INIS-mf–11457(v.1,2) v. 2) **Automatic discrimination and read-out of tracks of RaA and RaC' on CR39 using image analysis.** Pai, H.L. (R.A.D. Service and Instruments Ltd., Toronto, ON (Canada)). Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

At the 7th International Conference on Solid State Dosimetry, we reported that the tracks of RaA and RaC' in a CR39 detector could be separated by means of size discimination. At this meeting, we will report the latest development of the automatic discrimination and read-out of the tracks of RaA and RaC' on CR39 using conventional electronic image analysis equipment.

39054 (INIS-mf–11457(v.1,2) v. 2) **EROS - 'electronic' radon observation system.** Annanmaki, M. (Institute of Radiation Protection, Helsinki (Finland)); Oksanen, E. Canadian Nuclear Association,

Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

To be able to measure long period mean radon concentrations we have constructed a radon detector called EROS. The function of EROS is based on electrostatic collection of charged Po-218 atoms on an aluminum foil. A cellulose nitrate film is used as detector material. The alphas from Po-214 on the foil are collimated before they reach the cellulose nitrate film. The collimation and partial absorption of the energy of the alpha particles cause them to traverse the cellulose nitrate film perpendicularly and to have about the same energy, making the holes to be counted regular in shape and size. After a measurement and period of about one month, the film is etched in NaOH. The film reading is performed using a microscope or a microfiche reader. The response of EROS depends on the relative humidity of the air. The minimum detectable concentration of EROS in a one-month period is about 40 Bq/m^3 (1 pCi/1).

39055 (INIS-mf–11457(v.1,2) v. 2) **Metrology of radon and thoron daughters.** Phillips, C.R. (Toronto Univ., ON (Canada). Dept. of Chemical Engineering and Applied Chemistry). Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Based on an understanding of the nature and properties of the mine aerosol, particularly in terms of size, unattached fraction, charged fraction and equilibrium ratio, the status of techniques for grab sampling, continuous monitoring and personal dosimetry in the metrology of the daughters of radon and thoron is reviewed. The nature and degree of optimization of single point approximate and exact methods of grab sampling are discussed, with emphasis on uncertainties. Continuous monitoring modes of greatest promise are identified, together with modes unsatisfactory in the presence of thoron daughters. Personal dosimeters based on thermoluminescent, track etch and solid state detectors are compared in terms of both theoretical limitations and operating performance. Finally, the potential of passive dosimetry is discussed. 98 refs.

39056 (INIS-mf–11457(v.1,2) v. 2) **Activated carbon filter for measurement of radon and thoron.** Wang Ruikai (Research Inst. of Uranium Mining, Hengyan (Cote d'Ivoire). Dept. of Mine Ventilation and Radiation Protection); Wang Mingchang; Li Hongquan; Wang Shengde; Tian Mengxia. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

This paper describes a new method called active carbon filter and an instrument named model KF-601, which can be used for the measurement of radon and thoron concentration. Exact results can be given in 10-18 minutes with a digital display. The lowest limits of radon and thoron measurement for the KF-601 are 0.74Bq/L(2x10^{-11} Ci/L) and 1.11Bq/L(3x10^{-11} Ci/L) respectively.

39057 (INIS-mf–11457(v.1,2) v. 2) **Mine tests of a passive electret dosimeter for radon/thoron daughters.** Khan, A. (Toronto Univ., ON (Canada). Dept. of Chemical Engineering and Applied Chemistry); Phillips, C.R. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The properties of permanently charged electret foils in collecting radon daughters were examined in the laboratory. Based on the results of these experiments, a passive radon daughter dosimeter was designed. Six of these dosimeters were then exposed in a Canadian uranium mine in two separate tests for periods of up to five days. In the second mine test four out of six dosimeters performed satisfactorily. Electrets in the two remaining dosimeters were damaged accidentally during the test period. This paper describes the design of the electret dosimeter and presents results of the two mine tests.

39058 (INIS-mf–11457(v.1,2) v. 2) **New capabilities for the measurement of natural radioactivity using low energy photons.** Schery, S.D. (New Mexico Inst. of Mining and Technology, Socorro (USA). Dept. of Geoscience). Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The new generation of co-axial N-type germanium detectors is characterized by improved sensitivity to low-energy photons and offers some new possibilities for measurement of natural radioactivity. Direct measurement of Pb-210, Th-234, and Th-230 in ore or tailings samples is one example where such detectors offer enhanced capability. Present detector designs could be improved further by making the entire housing from low attenuation materials. For detectors sensitive to photons below 25 keV it may be possible to use L x-rays to assay certain members of the radioactivity series that emit essentially no higher energy photons. In this paper are reported prototype measurements of a mono-isotopic sample and U-238, U-234, and Th-234 in a sample of uranium oxide.

39059 (INIS-mf–11457(v.1,2) v. 2.) **Pylon 190 Standard: a novel filter calibration standard for alpha spectrometry.** Vandrish, G. (Pylon Electronic Development Co. Ltd., Ottawa, ON (Canada)); Theriault, K.; Ryan, F. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The suitability of the Pylon Type 190 Standard for the calibration of Alpha Spectrometers and working level meters is described. An analysis has been made of the factors which influence the deposition of radon and thoron progeny within a closed cavity. With proper system design the magnitude and uniformity of deposition on a filter are predictable to +/-5%. In addition, reference peak energies are ideal for the calibration and alignment of alpha measuring instrumentation.

39060 (INIS-mf–11459, pp. 33) **"SIMULA", a simulation program for spectra obtained from neutron activation analysis.** Arbildo, A. (Instituto Peruano de Energia Nuclear, Lima (Peru)); Mendoza, P.; Espinosa, R. Sociedad Quimica del Peru, Lima (Peru). Oct 1987. (In Spanish). (CONF-8710479–: 15. Peruvian Congress of Chemistry, Lima (Peru), 12-17 Oct 1987). In *Resumenes de los trabajos.* Order Number DE89012192/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

SPECTRA/computerized simulation; ACTIVATION ANALYSIS; NEUTRONS; SIMULATION; SPECTRA

39061 (INIS-mf–11480, pp. 34) **On dose-rate determinations at a thermal neutron beam.** Wladkowski, J. Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik. Nov 1988. (In German). In *Annual report of the Institute for Theoretical Physics in Graz, Austria.* Order Number DE89631627/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

THERMAL NEUTRONS/neutron dosimetry; DOSE RATES; FAST NEUTRONS; MEASURING INSTRUMENTS; PROGRESS REPORT; QUALITY FACTOR

39062 (INIS-mf–11480, pp. 5) **Fields and charge distributions in counter tubes of quadratic cross-section.** Schnizer, B. (Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik). Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik. Nov 1988. (In German). In

Annual report of the Institute for Theoretical Physics in Graz, Austria. Order Number DE89631627/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

COUNTING TUBES/charge distribution; COUNTING TUBES/electromagnetic fields; PROGRESS REPORT; TWO-DIMENSIONAL CALCULATIONS

39063 (INIS-mf-11480, pp. 39-40) **Gamma spectrometric measurements on environment samples.** Meisel, S.; Graller, P.; Kahr, G.; Ninaus, W.; Oswald, K.; Rabitsch, H. Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik. Nov 1988. (In German). In *Annual report of the Institute for Theoretical Physics in Graz, Austria.* Order Number DE89631627/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

ENVIRONMENT/radioactivity; ACCURACY; AUTOMATION; CALIBRATION; ENVIRONMENT; RADIOACTIVITY; GAMMA SPECTROSCOPY; MEASURING INSTRUMENTS; PROGRESS REPORT

39064 (INIS-SU-78, pp. 237-241) **Identification and spectrometry of charged particles from the (n,p) and (n,α) reactions using ionization chamber with two grids.** Gladenov, Yu.M. (Joint Inst. for Nuclear Research, Dubna (USSR)); Kvitkova, N.I.; Mitrikov, M.P.; Mitrikova, R.S.; Tishin, V.G.; Fung Van Zuan. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959--: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

A method of identification and spectrometry of the low-energy charged particles on the base of the ionization chamber with two grids is reported. The efficiency in the operation and the main effects of the application of the method are presented. 8 refs.; 4 figs.

39065 (JET-R-88-13) **Soft X-ray detectors for the spectral and spatial scanning double crystal monochromators KS1 and KS2 at JET.** Rupprecht, G. Commission of the European Communities, Abingdon (UK). JET Joint Undertaking. 1988. 23p. Order Number DE89631564/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

We describe the large area multiwire proportional counters used as detectors with the soft X-ray double crystal monochromators at JET. These detectors work in the energy range from 0.54 keV to 11.3 keV with their main features being efficient rejection of background radiation and a high count rate capability of 10^7 photons/s.

39066 (KEK-88-5) **Radiation detectors and their uses.** Miyajima, M.; Sasaki, S.; Doke, T. (eds.). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Jul 1988. 202p. (CONF-8802136--: 2. workshop on elementary-particle picture of the universe, Tsukuba, Japan, 4-6 Feb 1988). Order Number DE89012160/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Individual papers in these proceedings are separately indexed.

39067 (KEK-88-5, pp. 9-29) **Mechanism of self-quenching streamer and application to nuclear radiation detection.** Matoba, M. (Kyushu Univ., Fukuoka (Japan)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Jul 1988. (CONF-8802136--: 2. workshop on elementary-particle picture of the universe, Tsukuba, Japan, 4-6 Feb 1988). In *Radiation detectors and their uses.* Order Number DE89012160/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

Mechanism of the self-quenching streamer (SQS) mode in a gas counter and its application to nuclear radiation detection are reviewed briefly. New data of SQS transitions in Kr-based mixture gases are shown. (author) 74 refs.

39068 (KEK-88-5, pp. 1-4) **SQS phenomenon and its application to radiation detectors.** Doke, Tadayoshi (Waseda Univ., Tokyo (Japan). Science and Engineering Research Lab.). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Jul 1988. (CONF-8802136--: 2. workshop on elementary-particle picture of the universe, Tsukuba, Japan, 4-6 Feb 1988). In *Radiation detectors and their uses.* Order Number DE89012160/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

Although specialists in the field of electric discharges have known about the streamer phenomenon for many years, the discovery of the SQS phenomenon was made by detector physicists, many of whom were not so familiar with the underlying theory of electrical discharges. Consequently, many specialists in the field of electric discharges are still not fully aware of the existence and the potential importance of the SQS mode. This may be one of the principal reasons why the mechanism responsible for the SQS mode is still not fully understood. If the potential importance of the SQS phenomenon were to be emphasized to specialists in the field of electrical discharges, they would surely have a deep interest in it, and from this interest many useful insights would certainly follow. What is needed is an understanding of the underlying physical mechanism responsible for the SQS phenomenon ahd its dependence on the independent variables such as voltage, the identity of gases, their concentrations, etc. Accelerator physicists have shown a great interest in detectors based on the SQS phenomenon. Such detectors can have extensive applications outside the fields of high energy and nuclear physics. By selecting the gases and their pressures advantageously it should be possible to develop SQS detectors that are equal to or better than GM counters. (N.K.).

39069 (KEK-88-5, pp. 5-8) **Mechanism of a self-quenching streamer (SQS) in a gaseous radiation counter: an introduction.** Ogawa, Iwao (Rikkyou Univ., Tokyo (Japan)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Jul 1988. (CONF-8802136--: 2. workshop on elementary-particle picture of the universe, Tsukuba, Japan, 4-6 Feb 1988). In *Radiation detectors and their uses.* Order Number DE89012160/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

An attempt is made at understanding systematically some significant characteristics of an SQS discharge and their physical backgrounds. The most natural mechanism for the generation and growth of an SQS would be: (1) the space charge of positive ions produced by an electron avalanche near the central wire generates a strong local electric field in the vicinity of the cathode (wall) side end of the ion cloud, (2) some of the gas molecules in this region are photoionized by UV photons emitted from the electron avalanche, (3) the liberated photoelectrons give rise to new electron avalanches beyond the end of the existing space charge, and (4) these three processes are related successively, making an SQS develop rapidly toward the cathode wall. If the tube voltage space charge are small, electron avalanches will be reproduced always along the surface of the central wire, where the electric field is always stronger than anywhere in the tube, leading to an ordinary proportional- or GM-mode discharge. Assuming this mechanism, a rough study is made on the electric field intensities at various relevant positions in the tube as a function of the tube voltage, particularly at those points located in the average range of UV photons emitted from the original electron avalanche. (Nogami, K.).

39070 (KEK-88-5, pp. 72-79) **High field electron transport in liquefied rare gases.** Sakai, Y. (Hokkaido Univ., Sapporo (Japan). Faculty of Engineering). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Jul 1988. (CONF-8802136--: 2. workshop on elementary-particle picture of the universe, Tsukuba, Japan, 4-6 Feb 1988). In *Radiation detectors and their uses.* Order Number DE89012160/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

Large values of electron drift mobility in liquids are one of the necessary conditions for the construction of liquid radiation detectors. Liquid Ar, liquid Xe, TMS, etc., satisfy this condition. It is very important to make clear the behavior of electrons in high field strengths in these liquids, in order to improve the detectors. The present article reports electron transport parameters in liquid Ne, Ar, Kr and Xe analyzed using the Cohen-Lekner theory. The effective cross sections for electrons collision with liquid atoms are discussed, and experimental values of drift velocities are presented. The electron drift velocity is measured in TOF system, injecting electrons with a short pulse width from the cathode by irradiation of UV pulse light. Then the velocity is given as the ratio of the electrodes distance to the drift time which is determined from the current waveform. Study results show that the electron transport behavior in liquid Ar, liquid Kr

and liquid Xe can be understood quantitatively in the framework of the Cohen-Lekner theory. The present values of the effective electron collision cross sections in the liquids give the drift velocity and characteristic energy of electrons consistent with experimental values. The saturation drift velocity in liquid Ne is 1.1 cm/s. (N.K.).

39071 (KEK–88-5, pp. 87-95) **Dual type gridded ionization chamber as purity monitor of liquid argon.** Utsumi, M. (Waseda Univ., Tokyo (Japan). Science and Engineering Research Lab.); Kikuchi, J.; Doke, T. and others. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Jul 1988. (CONF-8802136–: 2. workshop on elementary-particle picture of the universe, Tsukuba, Japan, 4-6 Feb 1988). In *Radiation detectors and their uses.* Order Number DE89012160/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

The liquid argon time projection chamber (LATPC) is currently developed for detecting solar neutrons or proton decays. A dual type gripped ionization chamber with different drift distances of liberated electrons is constructed to measure the purity of liquid argon. A purification system of gaseous argon for LATPC with a drift space of about 150 cm is also constructed. The performances of both the dual type gripped ionization chamber and the purifier are tested seeking to develop a large scale LATPC. It is demonstrated that the attenuation length of electrons and also the impurity level in liquid argon can be well determined in the dual type gripped ionization chamber. In the case of the purifier, there still remains unknown low-level impurities in purified liquid argon. The results are compared with UCI data which were obtained with liquid argon mixed with water vapor. the same tendency is found in the attenuation length of their data as in the present results. This seems to suggest the dominant impurity remaining in the purifier is still water. The present apparatus was previously tested with liquid argon purified by other purification system of Ti-Ba getters. The attenuation length obtained by those tests was almost 100 cm. (N.K.).

39072 (KEK–88-5, pp. 96-102) **Energy resolution for α-particles in doped liquid argon.** Masuda, K. (Saitama Coll. of Health, Urawa (Japan)); Shibamura, E.; Sano, T.; Hitachi, A.; Doke, T. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Jul 1988. (CONF-8802136–: 2. workshop on elementary-particle picture of the universe, Tsukuba, Japan, 4-6 Feb 1988). In *Radiation detectors and their uses.* Order Number DE89012160/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

The report describes experiments on the effect of allene doped in liquid argon. In the case of doped argon, a large amount of charge is obtained even at low electric fields and the measured charge increases with the field gradually. This can be explained as follows; part of deposited energy which does not form charge in pure argon contributes to charge signal in doped argon through scintillation photons which ionize allene molecules. The main factors determining the energy resolution for α-particles are considered to be (1) fluctuation in the number of produced ion-electron pairs as expressed by the Fano factor, (2) fluctuation in recombination process, (3) fluctuation in photoionization, (4) fluctuation due to the condition of radioactive source and surface of electrodes, (5) fluctuation in geometrical efficiency due to the range and emission angle of α-particles in liquid argon, and (6) electronic noise of amplifier. The factors (1) and (3) can be neglected because of a large number of associated electrons or photons. In pure liquid argon, the factor (2) may be a cause of bad resolution since the fraction of the produced ion-electron paris which do not recombine is small and the photoionization process never occurs for photons emitted through recombination. (N.K.).

39073 (KEK–88-5, pp. 126-141) **New type of luminescence mechanism in BaF_2 and CsF. Proposal for the fast scintillation materials.** Kubota, Shinzou (Rikkyo Univ., Tokyo (Japan)); Ruan, Jian-zhi; Itoh, Minoru; Hashimoto, Satoshi; Sakuragi, Shiro. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Jul 1988. (CONF-8802136–: 2. workshop on elementary-particle picture of the universe, Tsukuba, Japan, 4-6 Feb 1988). In *Radiation detectors and their uses.* Order Number DE89012160/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

Fast luminescence components of BaF_2 (180 - 230 nm), CsF (220 - 500 nm). CsCl (200 - 300 nm), CsBr (220 -280 nm), and RbF (200 - 450 nm) have been investigated at room temperature using synchrotron radiation as a light source. These luminescences have the excitation thresholds at the energies from the outermost Ba^{++} 5p, or M^{+} mp (m = 4 and 5 for M = Rb and Cs. respectively) core state to the conduction band and are attributed to the radiative decay of electrons in X^{-} np halogen valence bands (n = 2, 3, and 4 for X = F, Cl and Br. respectively) to the outermost-core hole states. From the above results, it is proposed that insulators, their band-gap being larger than the energy difference between the valence band and the outermost core state, are candidates for the fast scintillation materials, for example, $BaCl_2$, $BaBr_2$, and BaI_2.

39074 (KEK–88-5, pp. 142-150) **Fabrication of GaSe radiation detectors and the detection of alpha particles.** Yamazaki, Toshinari (Toyama Univ. (Japan). Faculty of Engineering); Nakatani, Hideo; Sakai, Eiji. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Jul 1988. (CONF-8802136–: 2. workshop on elementary-particle picture of the universe, Tsukuba, Japan, 4-6 Feb 1988). In *Radiation detectors and their uses.* Order Number DE89012160/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

GaSe has been studied as a radiation detector which operates at room temperature. In this study the effect of Ge doping was investigated. The energy resolution for ^{241}Am 5.5 MeV alpha particles did not improve by the addition of Ge, inspite of the substantial decrease in the leakage current. Nevertheless, it is noteworthy that all detectors with Ge concentration from about 0.01 to 1 at% showed fairly good energy resolutions not so inferier to the best one of pure GaSe detectors, although many pure GaSe detectors did not operate because of their too large leakage currents.

39075 (KEK–88-5, pp. 171-179) **Neutron radiography imaging with 2-dimensional photon counting method and its problems.** Ikeda, Y. (Nagoya Univ. (Japan). Faculty of Engineering); Kobayashi, H.; Niwa, T.; Kataoka, T. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Jul 1988. (CONF-8802136–: 2. workshop on elementary-particle picture of the universe, Tsukuba, Japan, 4-6 Feb 1988). In *Radiation detectors and their uses.* Order Number DE89012160/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

A ultra sensitive neutron imaging system has been deviced with a 2-dimensional photon counting camara (ARGUS 100). The imaging system is composed by a 2-dimensional single photon counting tube and a low background vidicon followed with an image processing unit and frame memories. By using the imaging system, electronic neutron radiography (NTV) has been possible under the neutron flux less than 3×10^4 n/cm^{2}center dots.

39076 (KEK–88-5, pp. 193-195) **CsI-photodiode detector with a rise time discriminator capable of spurious pulse rejection.** Hosono, Yoneichi (Tokyo Univ. (Japan). Faculty of Engineering); Hasegawa, Ken-ichi. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Jul 1988. (CONF-8802136–: 2. workshop on elementary-particle picture of the universe, Tsukuba, Japan, 4-6 Feb 1988). In *Radiation detectors and their uses.* Order Number DE89012160/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

A CsI-photodiode gamma-ray detector with a rise time discriminator has been constructed which can reject pulses produced by gamma-rays directly absorbed in the photodiode.

39077 (KEK–88-5, pp. 103-116) **Proportional counters for low and high temperature uses.** Isozumi, Y. (Kyoto univ. (Japan). Radioisotope Research Center); Fujii, T.; Katano, R.; Kishimoto, S. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Jul 1988. (CONF-8802136–: 2. workshop on elementary-particle picture of the universe, Tsukuba, Japan, 4-6 Feb 1988). In *Radiation detectors and their uses.* Order Number DE89012160/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

A series of studies on the operation of gas-filled proportional counter at various temperatures (1.5~1100K) have been continued at Radioisotope Research Center of Kyoto University. Different contrivances for counter structure and filling gas are necessary to operate a gas-filled counter in different temperature regions. Most of the new proportional counter techniques developed by the authors have been applied to the resonance-electron Moessbauer spectroscopy (REMS) at low and high temperatures. Typical examples of

REMS data obtained by the authors' counter techniques are also given. The report first outlines counter operations in the temperature ranges of 0~4.2K, 4.2~30K, 30~77K, 77K~0degC, 0~300degC and 300~800degC. Then application to Moessbauer spectroscopy is discussed. The present techniques for gas-filled proportional counter can detect radiations in the very low temperature region, ~30K, and also in the region of 70K to 800degC. However, there remains a problem of developing some detection technique in the region of 30~70 K; the helium-filled counter suffers from continuous discharge which is caused by the Penning ionization of impurities gas in the filling helium. The problem may be solved by employing semiconductor detectors, such as pure Si or Si(Li), and gas scintillation counters filled with He/Ne mixtures. (N.K.).

39078 (KEK–88-5, pp. 117-125) **Feasibility studies of high-pressure 4π proportional counter for absolute activity measurement.** Hino, Y. (Electrotechnical Lab., Tsukuba, Ibaraki (Japan)); Kawada, Y. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Jul 1988. (CONF-8802136–: 2. workshop on elementary-particle picture of the universe, Tsukuba, Japan, 4-6 Feb 1988). In *Radiation detectors and their uses.* Order Number DE89012160/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

A high-pressure proportional counter system is constructed. The high pressure $4\pi\beta$ counter system constructed is made of aluminum and is divided into two 2π counters. The gas pressure is controlled with a pressure regulator and very fine leak valves to keep the balance of a stable pressure and constant flow rate. Investigation of characteristics of th counter shows that there is an almost linear relation between voltage and pressure. The linearlity of gas gain of this counter to the electron energies is measured with different gas pressures. Quite good linear gas multiplication is obtained at 0.9 MPa. Another investigation is made of application of to activity measurement of ^{109}Cd. When the gas pressure is over 0.5 MPa, the proportion of collected conversion electrons to absolute activity comes to a constant value of 96 %. This is quite good agreement with the decay data of 96.4 % conversion electron emission rate. The study indicated many excellent features for activity measurement. Especially the efficiency variation technique is good for automatic data acquisition with a programmable high voltage supplier. Moreover, since it is possible to obtain absolute activity with only one sample, it will be quite useful for limited samples experiments. (N.K.).

39079 (KEK–88-5, pp. 151-160) **Precise measurements of temperature dependence of NaI (Tl) scintillations.** Yamashita, Mikio (Electrotechnical Lab., Tsukuba, Ibaraki (Japan)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Jul 1988. (CONF-8802136–: 2. workshop on elementary-particle picture of the universe, Tsukuba, Japan, 4-6 Feb 1988). In *Radiation detectors and their uses.* Order Number DE89012160/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

The author has recently developed a novel method of measuring the intensity of light pulses, employing a photon counting technique, which permits accurate and successive measurements of variations in light pulse intensity, free from the changes in PMT gain. In the present work, an attempt is made to apply the method to measurement of the temperature dependence of scintillations in NaI(Tl) crystals. It is a unique feature of the present experiment that temperature coefficients of both 'scintillation' and 'scintillation + phosphorescence' can be simultaneously measured by the new method with reasonable accuracy. The scintillations are produced in an 1.5" x 1.75" NaI(Tl) crystal excited by Cs-137 gamma-rays (0.662 MeV). The crystal is optically coupled to a PMT through a lucite light guide so that the scintillations are introduced to the PMT with a reasonable high efficiency. Fiber optics is employed to transmit a small portion of scintillations from the NaI(Tl) crystal to a particular type of PMT kept at a constant temperature in another thermostatic chamber, and used to measure the variations in scintillation yield. The temperature coefficients of 'scintillations' and those of 'scintillation + phosphorescence' determined are presented. (N.K.).

39080 (KEK–88-5, pp. 161-170) **Models of formation and erosion of a plasma column in a silicon surfacebarrier detector.** Kanno, Ikuo (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Jul 1988. (CONF-8802136–: 2. workshop on elementary-particle picture of the universe, Tsukuba, Japan, 4-6 Feb 1988). In *Radiation detectors and their uses.* Order Number DE89012160/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

Silicon surface barrier detectors (SSBs) have two demerits in measurement of heavy ions, namely, pulse-height defect (PHD) and plasma delay. Both of these phenomena are ascribed to the formation of a plasma column in the silicon due to the incident heavy ion. One of the three major sources of PHD, i.e., energy dissipated by the recombination of electron-hole pairs in the plasma column, has not been explained quantitatively. To estimate the recombination effect quantitatively and to explain the electric field strength dependence of the plasma delay, the present report proposes new models of the formation and erosion of the plasma column. With the model of the plasma column formation, the volume, the surface area of the plasma column and the density of the electron-hole pairs can be calculated. In the model of the erosion of the plasma column, it is postulated that the plasma delay is the time interval between the formation of the plasma column and the beginning of its erosion, and that the erosion is caused by the change of the dielectric constant inside the plasma column, i.e., the change from a conductor-like plasma column to a dielectricity-like one. With this model, the dependence on the electric field strength of the plasma delay is derived. (N.K.).

39081 (KIFVE–88-03) **Computer-aided system for X-ray emulsion chambers data processing.** Emel'yanov, Yu.A.; Ivanenko, V.M.; Lisitsa, G.I. and others. AN Kazakhskoj SSR, Alma-Ata (USSR). Inst. Fiziki Vysokikh Ehnergij. 1988. 23p. (In Russian). Order Number DE89631546/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Automated system for processing data from X-ray emulsion chambers, designed for measuring energy of cosmic ray γ-quanti and their spatial characteristics - coordinates and angles of γ-quanta divergence trajectories has been created. The system is based on the complex of hardware components, presented by SM computer, "E-60" microcomputer, IVK-20 and CAMAC system. The system is composed of three subsystems ("Pamir", "Adron-44" and "Stratosfera") and enables to control the quality of photometric measurement, to display the field of microscope vision in order to count the number of tracks and to measure their coordinates, provides successive formation of data bank at the external magnetic storage. 5 refs.; 10 figs.

39082 (KIYI–88-12) **Technique and experimental equipment for the investigation of inner shell ionization of free metal atoms by electron impact.** Solomon, A.M.; Vukstich, V.S.; Zhmenyak, Yu.V.; Pashchenko, V.S. AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yademykh Issledovanij. 1988. 25p. (In Russian). Order Number DE89631565/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

An original experimental setup for investigation of characteristic X-ray and Bremsstrahlung yield due to the collisions of metal atoms with electrons of keV energies is described. The method of the investigation of vacancy generation in inner electron shells of atoms by means of X-ray spectroscopy in crossed electron and atom beams is analyzed. The firstly obtained results on double differential Bremsstrahlung excitation cross section of electrons under collision with potassium atoms versus emitted photon energies are presented together with effective cross section data on K-shell ionization of potassium atom by electrons with energies up to 45 keV. 27 refs.; 5 figs.

39083 (LA–11643-M) **Calibrating the Jomar JPM-22 pedestrian SNM monitor.** Fehlau, P.E. Los Alamos National Lab., NM (USA). Aug 1989. 15p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-36. Order Number DE89010726/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Jomar JPM-22 is a commercial version of a portal monitor developed at Los Alamos. The monitor operates as a walk-through or wait-in SNM monitor. This manual describes how to calibrate the monitor's detection system and how to set its operating parameters for walk-through or wait-in operation. 4 figs., 2 tabs.

39084 (LAPP-EXP–88-14) **Photomultipliers gain monitoring at the one percent level with a blue light pulser.** Berger, J.; Bermond, M.; Besson, P.; Favier, J.; Pessard, H.; Poulet, M. Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules. Jul 1988. 19p. (CONF-8806235–: International conference on advanced technology and particle physics, Como, Italy, 12-17 Jun 1988). Order Number DE89791988/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

We describe a method and an experimental layout allowing the monitoring of photomultipliers gain. We use artificial blue light (Spark-gap with filter: 436 $\pm$ 20 nm) and three reference detectors. Short term and long term measurements are presented. The results indicate a precision better than 0.5% for the short term and 1.4% for the long term determinations. This gain monitoring system has been developed for a new neutrino oscillation reactor experiment (600 photomultipliers) starting at the Bugey nuclear plant.

39085 (LAPP-EXP–88-15) **First use of a neutron burst generator to calibrate a U-TMP calorimeter.** Aubert, B.; Colas, J.; Ghez, P.; Lacotte, J.C.; Mours, B.; Wingerter, I.; Yvert, M. Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules. Jul 1988. 25p. (CONF-8806235–: International conference on advanced technology and particle physics, Como, Italy, 12-17 Jun 1988). Order Number DE89791987/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A TMP ionization chamber, prototype of a basic element of the UA1 upgraded calorimeter, was exposed to a neutron burst generator. The electrons life time in the liquid was successfully measured with this technique which looks very promising as a calibration method.

39086 (UCRL–50007-87, pp. 93-99) **Recent developments in CR-39 personnel neutron dosimetry.** Hankins, D.E.; Homann, S.G.; Westermark, J. Lawrence Livermore National Lab., CA (USA). Jul 1988. In *Hazards Control Department annual technology review, 1987.* Order Number DE89002470/JAW. Available from NTIS, PC A07/MF A01.

The authors are continuing to study various technical aspects of electrochemically etched CR-39 foils used as personnel neutron dosimeters. These studies include determining the energy response and the changes in the energy dependence caused by etching the back of the foil. They are also performing measurements of the angular dependence in air and on a phantom as a function of neutron energy. A method to identify the individual CR-39 foils by using laser numbering is also being investigated. 6 references, 5 figures, 1 table.

39087 (UCRL–50007-87, pp. 100-102) **Use of neutron-sensitive personnel TLDs as flags for CR-39 processing.** Hankins, D.E. Lawrence Livermore National Lab., CA (USA). Jul 1988. In *Hazards Control Department annual technology review, 1987.* Order Number DE89002470/JAW. Available from NTIS, PC A07/MF A01.

To avoid the cost and time required to read all of the CR-39 dosimetry foils issued to personnel, the author made a study to determine if he could use thermoluminescent dosimeter (TLD) readings from the thermal-neutron-sensitive TLD in the Panasonic personnel badge as a flag to indicate if a particular CR-39 foil should be processed. He found this to be true: only a small percentage of low neutron doses would be missed if the TLD-flag procedure were used. 3 tables.

39088 (UCRL–50007-87, pp. 103-106) **Study of the spectrum-dependent track-size distribution of electrochemically etched CR-39 foils.** Hankins, D.E.; Homann, S.G.; Westermark, J. Lawrence Livermore National Lab., CA (USA). Jul 1988. In *Hazards Control Department annual technology review, 1987.* Order Number DE89002470/JAW. Available from NTIS, PC A07/MF A01.

The authors investigated the parameters that affect the track-size distribution on electrochemically etched CR-39 foils. They found that the largest differences in track-size distribution occur when the foils are etched at 3000 V for 3 hours at 60 Hz, followed by 40 minutes at 2000 Hz. Track-size analysis can be used to determine (within limits) information on the incident-neutron spectrum and to determine if the reading on a foil is a true neutron exposure or a foil with a high background. A new image analyzer is being developed at LLNL that will allow track-size analysis without increasing the time presently required to evaluate the foils. 1 reference, 2 figures.

39089 (UCRL–50007-87, pp. 107-110) **Response of a liquid-scintillator fast-neutron spectrometer as a function of the angle of neutron incidence.** Thorngate, J.H. Lawrence Livermore National Lab., CA (USA). Jul 1988. In *Hazards Control Department annual technology review, 1987.* Order Number DE89002470/JAW. Available from NTIS, PC A07/MF A01.

The author conducted measurements that show the angle of neutron incidence does not affect the fast-neutron spectra measured with a liquid-scintillator if the scintillator has the shape of a right circular cylinder with equal diameter and height. This is true even when efficiency functions used to reduce the data assume a plane wave of neutrons incident along the axis of the scintillator. 1 reference, 3 figures, 1 table.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

Refer also to citation(s) 38965

4403 Miscellaneous Instruments

Refer also to citation(s) 38065, 38151, 38152, 38235, 38877, 38896, 38992, 39104, 39164, 39263

39090 (CEA-CONF–9817) **Fiber optic spectrophotometer with photodiode linear array.** Blanc, F.; Vernet, P.; Velluet, M.T. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Chimie Appliquee et d'Etudes Analytiques. 1988. 6p. (CONF-8809105–: SPIE O-E Laser: international symposium and exhibition on fiber optics, optoelectronics and laser applications, Boston, MA, USA, 6-10 Sep 1988). Order Number DE89792019/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

Spectrophotometric measurements are used in a great number of industrial processes, in nuclear environment and with optical precision components. Especially the evolution of a chemical process or of an optical coating could be followed by these measurements. Spectrophotometers, using optical fibers to transport the signal out of the instrument make possible the measurement "in-situ" and in real time. The advantage of using a diode array to detect the signal is an instantaneous measurement all over the spectral range without moving parts. It allows an excellent reproductibility. The instrument is controlled by a micro computer. The spectrophotometer is described and technical performance presented. An extension using optical fibers on a "classical" spectrophotometer (a H.P. one) is also described and technical performance presented.

39091 (KIYI–88-27) **Differential discriminator with time coupling channel.** Urin, V.N.; Isaev, A.G. AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. 11p. (In Russian). Order Number DE89631575/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The fast differential discriminator with time coupling channel for use with scintillation and semiconductor detectors is described. Discriminator provides the time resolution better than 80 ps for pulse amplitude (0,05-5,5)V and pulse rise times (2,5-22)ns. 7 refs.; 4 figs.

39092 (LBL-PUB–658) **Users guide to NCEMSS: Version 1.0.** Lawrence Berkeley Lab., CA (USA). May 1989. 56p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE89015447/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Image simulation grew out of an attempt to explain why electron microscope images of complex oxides sometimes showed black dots in patterns corresponding to the patterns of heavy metal sites in complex oxides, and yet other images sometimes showed white dots in the same patterns. This first application was therefore to characterize the experimental images, that is to relate the image character (the patterns of light and dark dots) to known features in the structure. Some simulations are done in order to thoroughly explore one particular image by "freeze-framing" the imaging process

in the computer. The simulation programs can also be used to study the imaging process itself.

39093 (PNL-SA–17003) **Spectral and temperature correction of silicon-photodiode solar radiation detectors.** Michalsky, J.J.; Perez, R.; LeBaron, B.A. Pacific Northwest Lab., Richland, WA (USA). Jun 1989. 7p. Sponsored by DOE Energy Research. DOE Contract AC06-76RL01830. (CONF-890610–6: American Solar Energy Society annual meeting, Denver, CO, USA, 19-23 Jun 1989). Order Number DE89014917/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Silicon-photodiode sensors are inexpensive tools for the measurement of solar radiation. However, their temperature and spectral response problems make them unsuitable for direct beam and diffuse horizontal irradiance measurements unless they can be reliably corrected. A correction procedure is outlined and applied to two distinct data sets. After-correction, root-mean-square errors for the total and diffuse horizontal irradiance are less than 1% of full sun compared with thermopile measurements, and direct normal irradiance is just slightly larger than 1% of full sun. Application of one data set's correction factors to another data set indicates only slightly degraded accuracy improvements. 3 refs., 3 figs., 3 tabs.

39094 (SAND–87-0310) **Aircraft security radar development report.** Walker, B.C. Sandia National Labs., Albuquerque, NM (USA). Feb 1989. 112p. Sponsored by Department of Defense. DOE Contract AC04-76DP00789. Order Number DE89014574/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The protection of military aircraft on the ground against surreptitious access is a continuing problem. The US Air Force has initiated a program to develop portable electronic intruder-detection systems. As part of this program, the Aircraft Security Radar has been developed. The Aircraft Security Radar is a portable bistatic radar that will detect all intruders, from a small, creeping man to a high-speed vehicle, but that will not alarm on nearby traffic or aircraft motion. This radar is also relatively insensitive to nuisance alarms from rain and small targets such as birds. 22 refs., 107 figs., 8 tabs.

39095 (UCRL–99801) **Realtime tracking system for the wide-field-of-view telescope project.** Park, Hye-Sook; Axelrod, T.S.; Colella, N.J.; Colvin, M.E.; Ledebuhr, A.G. Lawrence Livermore National Lab., CA (USA). May 1989. 9p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890358–5: Society of Photo-Optical Instrumentation Engineers conference on applications of artificial intelligence, Orlando, FL, USA, 28-30 Mar 1989). Order Number DE89013787/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We are developing a wide-field-of-view (WFOV) telescope system for military, commercial and scientific purposes. The systems will have smart focal plane processors to recognize and track moving objects. This paper describes candidate algorithms intended for these processors which are currently implemented on a commercial image processing system interfaced to our prototype WFOV telescope. 4 refs., 8 figs.

39096 (UCRL–101242) **Model-based algorithms for limited data tomography.** Azevedo, S.G.; Schneberk, D.J.; Martz, H.E.; Skeate, M. Lawrence Livermore National Lab., CA (USA). Jun 1989. 6p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8907107–3: American Society of Nondestructive Testing topical conference, Seattle, WA (USA), 24-27 Jul 1989). Order Number DE89014047/JAW. Available from NTIS, PC A02/MF A01 - OSTI.

This survey paper briefly presents the recent application of model-based methods to the reconstruction of industrial computed tomography (CT) data. We survey many known methods, discuss the relevant issues, and relate our experiences. 24 refs., 2 tabs.

39097 Multimegabar pressures using synthetic diamond anvils. Ruoff, A. L. (Department of Materials Science and Engineering, Cornell University, Ithaca, New York 14853 (US)); Vohra, Y. K. *Applied Physics Letters (USA),* 55(3): 232-234 (17 Jul 1989).

Synthetic type 1*B* yellow diamonds containing nitrogen in single substitutional form, with extremely low birefringence, were used as anvils in a diamond anvil cell. The diamonds were well characterized by infrared and visible absorption spectra. Sensitive spectroscopic methods along with mechanical chopping techniques were used to record ruby fluorescence to 250–300 GPa, a pressure equal to or exceeding that attained with natural diamonds. Nitrogen platelets are *not* essential to attaining multimegabar pressures.

39098 Calibration of scanning tunneling microscope transducers using optical beam deflection. Wetsel, G. C., Jr. (Department of Physics, Southern Methodist University, Dallas, Texas 75275(US)); McBride, S. E.; Warmack, R. J.; Van de Sande, B. *Applied Physics Letters (USA),* 55(6): 528-530 (7 Aug 1989).

An accurate, sensitive, easily implemented method of calibration of the elastic displacement of piezoelectric transducers used in scanning tunneling microscopes has been developed. The axial displacement for both static and harmonic excitation has been measured using laser beam deflection amplified by an optical magnification system. For harmonic excitation where lock-in amplifier detection can be utilized, displacements as small as 0.03 A have been measured. Measurements on PZT-5H and PZT-8 transducers over a range of five orders of magnitude in applied voltage demonstrate the power of the method in calibration of displacements from the subangstrom to the nonlinear region with an uncertainty of about 4%.

39099 High resolution laser imaging system. Kyle, T. G. (Los Alamos National Laboratory, International Technology Division, P.O. Box 503, Los Alamos, New Mexico 87544 (US)). *Applied Optics (USA),* 28(13): 2651-2656 (1 Jul 1989).

Computations indicate that a synthetic aperture laser imaging system can provide images with 10-cm resolution at satellite ranges using a 10-W cw laser. When imaging satellites from the ground, the synthetic aperture system reduces atmospheric degradations. The system uses 20-cm diam receiver optics. The low laser power is made possible by using separate transmitter and receiver optics and coded pulses with a 50% transmitter duty cycle. The coded pulses are derived from Hadamard matrices for which there is an efficient algorithm to transform the received data into images. The synthetic aperture yields spatial resolutions independent of range, and the coded pulses result in an effective range dependence of r^{-2} instead of r^{-4}.

39100 Multilayer-coated blazed grating performance in the soft x-ray region. Rife, J. C. (U.S. Naval Research Laboratory, Washington, DC 20375-5000(US)); Cruddace, R. G.; Hunter, W. R.; Barbee, T. W., Jr. *Applied Optics (USA),* 28(15): 2984-2986 (1 Aug 1989). DOE Contract AC02-76CH00016.

Useful grating efficiencies for a variety of new spectrometer types have been attained. These results are discussed.

39101 Fabrication and testing of large area multilayer coated x-ray optics. Spiller, E. (IBM T. J. Watson Research Center, P.O. Box 218, Yorktown Heights, New York 10598(US)); Golub, L. *Applied Optics (USA),* 28(14): 2969-2974 (15 Jul 1989).

We discuss the procedures developed for the production and testing of multilayer x-ray mirrors on large figured optical surfaces. Methods which are generally useful for characterizing the performance of such optics are presented, as well as specific results from the production of a 25-cm diam Ritchey-Chretien telescope for a wavelength of Σ = 63.5 A. The latter is a two-mirror system, which places additional stringent requirements upon the accuracy and quality of the coatings.

4404 Well Logging Instrumentation

39102 High voltage supply for neutron tubes in well logging applications. Russell, D. To Dept. of Energy, Washington, DC. USA Patent 4,808,368. 28 Feb 1989. Filed date 15 Sep 1982. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

A high voltage supply is provided for a neutron tube used in well logging. The biased pulse supply of the invention combines DC and full pulse techniques and produces a target voltage comprising a substantial negative DC bias component on which is superimposed a pulse whose negative peak provides the desired negative voltage level for the neutron tube. The target voltage is preferably generated using voltage doubling techniques and employing a voltage

source which generates bipolar pulse pairs having an amplitude corresponding to the DC bias level.

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

Refer also to citation(s) 38874

39103 (LA-UR–88-2753) **Computation of a diverging Comp-B detonation.** Bukiet, B.G. Los Alamos National Lab., NM (USA). 1989. 11p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890811–1: 9. international symposium on detonation, Portland, OR (USA), 28 Aug - 1 sep 1989). Order Number DE88016238/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The expansion which occurs in diverging detonations weakens the wave and yields pressures and densities below those occurring in planar geometry. We study the problem of a spherically expanding detonation of Comp-B. The effect of varying the order of reaction as well as the rate law parameters (using an Arrhenius burn model) is studied. 14 refs., 3 figs.

39104 (MLM–3587(OP)) **Lasers in spectroscopy, holography, and photography from 500 to 1000 nanometers.** Dosser, L.R.; Stark, M.A. EG and G Mound Applied Technologies, Miamisburg, OH (USA). 1989. 8p. Sponsored by DOE Defense Programs. DOE Contract AC04-88DP43495. (CONF-8904237–1: Midwest conference on laser materials processing/clinical applications, Cincinnati, OH, USA, 20 Apr 1989). Order Number DE89014738/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Lasers are being used more and more extensively at Mound to evaluate our materials and components for quality and performance. In the Laser Diagnostic Laboratory alone, there are several types of lasers, each with its own special characteristics, that are used for this purpose. The diagnostic applications, as varied as the lasers that they are based on, have been designed either to increase our understanding of the chemistry and physics of our materials or to increase our understanding of how a specific device functions. 6 refs., 3 figs.

39105 (SAND–88-2947C) **Heat flux from a fuel-air detonation to a structure.** Geller, A.S. Sandia National Labs., Albuquerque, NM (USA). 1989. 23p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890819–9: ASME/AIChE national heat transfer conference, Philadelphia, PA, USA, 6-9 Aug 1989). Order Number DE89006768/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The heat flux to positions both inside and on the outer wall of a structure was measured by means of thin-film thermocouples during the detonation of a hydrocarbon fuel-air cloud. This test series consisted of two events: atmospheric detonation of 1000 and 3000 kg of propylene oxide. The measurement locations included positions with and without lines of sight to the fireball. The short durations of the test (~20 ms) required a very fast response time from the heat flux gauges. Medtherm model 302/Rh-Pt/Mullite gauges were chosen to measure the heat flux. This type of gauge consists of two overlapping metal films deposited on a ceramic disk substrate. The gauges were flush-mounted into the concrete walls of the structure to minimize any heat flux to the sides of the gauges. The ceramic disk was modeled as a semi-infinite slab with one-dimensional heat conduction (a treatment justified by an equilibrium thermodynamic calculation). A closed-form solution for the transient heat flux as a function of the surface temperature history was then applied to calculate the instantaneous heat flux. Before applying this formula, though, the temperature data were filtered with a Hanning filter using a sliding twelve-point (48 μs) window. This resulted in relatively smooth calculated heat flux profiles. The results of these tests showed a large heat flux (O(10^6) W/m^2) at positions with a direct line of sight to the cloud but a much lower flux at positions having no direct line of sight. 4 refs., 14 figs.

4502 Nuclear

Refer also to citation(s) 39146

39106 (LA-UR–89-1933) **An overview of radiography in chemical energy warhead research.** Hull, L.M. Los Alamos National Lab., NM (USA). 1989. 13p. Sponsored by Department of Defense. DOE Contract W-7405-ENG-36. (CONF-890885–4: Flash radiography topical symposium, Portland, OR (USA), 15-18 Aug 1989). Order Number DE89014022/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The high-speed objects and the considerable light, dust, and smoke characteristic of chemical energy warhead test firing necessitate the use of flash radiography as a major diagnostic tool. This paper reviews many of the applications of radiography to chemical warhead studies conducted by many researchers at Los Alamos National Laboratory. Each type of contribution is illustrated by a figure, and the contributors are listed by figure number at the end. The emphasis of the paper is on the relationship between the kind of information obtained and the radiographic technique employed. Details of the techniques are provided only when it is necessary for clarity. A few examples of analysis of the radiographic data are given, but they are in no way exhaustive. The applications span a wide spectrum of flash x-ray energies and fluence, from 150-keV commercial machines to the 30-MeV, 120-R PHERMEX* machine. Low-energy x rays are useful; in the study of small or low-density objects such as highly disrupted penetrators, fragments, or spall. Medium-energy x rays are useful when blast and fragment protection is necessary, such as in the study of penetrator interactions with reactive armor, or if a moderate penetrating x-ray capability is required. High-energy x rays are useful when the data desired are internal to the structure and significant penetrating x-ray capability is required. This division of the techniques according to energy is rather loose. Significant overlap does exist and, therefore, each new application deserves individual consideration. 14 figs.

39107 (SAND–87-0912) **Evaluation of systems and components for hybrid optical firing sets.** Landry, M.J.; Rupert, J.W.; Mittas, A. Sandia National Labs., Albuquerque, NM (USA). Jun 1989. 130p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89014399/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

High-energy density light appears to be a unique energy form that may be used to enhance the nuclear safety of weapon systems. Hybrid optical firing sets (HOFS) utilize the weak-link/strong-link exclusion region concept for nuclear safety; this method is similar to present systems, but uses light to transmit power across the exclusion region barrier. This report describes the assembling, operating, and testing of fourteen HOFS. These firing sets were required to charge a capacitor-discharge unit to 2.0 and 2.5 kV (100 mJ) in less than 1 s. First, we describe the components, the measurement techniques used to evaluate the components, and the different characteristics of the measured components. Second, we describe the HOFS studied, the setups used for evaluating them, and the resulting characteristics. Third, we make recommendations for improving the overall performance and suggest the best HOFS for packaging. 36 refs., 145 figs., 14 tabs.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

39108 (EML–504, pp. 153-180) **Meteorological data at Chester, NJ.** Juzdan, Z.R.; Leifer, R.; Silvestri, S. USDOE Environmental Measurements Lab., New York, NY (USA). Oct 1988. In *1985-86 biennial report of the EML regional baseline station at Chester, New Jersey*. Order Number DE89002705/JAW. Available from NTIS, PC A09/MF A01.

This is the eighth in a series of reports summarizing meteorological data obtained at Chester, NJ from January 1985 to December 1986. Precipitation data which represent the total accumulated precipitation in the form of water measured each day. The monthly

data are the total accumulated precipitation during the month. Next to each data point is the number of hourly samples on which the daily data are based. Solar radiation and wind data were also collected from January 1985 to June 1986. Local visibility data from January 1985 to July 1985, these data have been derived from β-scattering measurements obtained with an integrating nephelometer. Also shown are daily and monthly averages of the temperature and dew point at 1 m from January 1985 to June 1986. The relative humidity is derived from the temperature and dew point temperature data a 1 m.

39109 Optical scattering and absorption by branched chains of aerosols. Iskander, M. F. (University of Utah, Department of Electrical Engineering, Salt Lake City, Utah 84112(US)); Chen, H. Y.; Penner, J. *Applied Optics (USA),* 28(15): 3083-3091 (1 Aug 1989).

We utilize the Volume Integral Equation Formulation (VIEF) and the method of moments to calculate the electromagnetic scattering and absorption of aerosol particles with branched-chain structures. Two kinds of polarization of the incident electromagnetic wave were considered: the cross- and end-fire polarizations. The numerical results of internal electric field distribution, absorbed power, and extinction and scattering cross sections, obtained from the VIEF, show excellent agreement with the Mie theory for the special case of spherical particles. Comparison between the results of the VIEF and Iterative Extended Boundary Condition Method for very long oriented (elongated) chains of particles also showed good agrement. After validating the accuracy of the VIEF, the absorption characteristics of three branched-chain structures simulated from microscopic pictures of coagulated smoke aerosol particles were calculated. Results showed that the ratio of absorption in the two polarization cases, $P_{cross-fire}/P_{end-fire}$, for very long oriented chain structures is as high as a factor of 4 at lower frequencies (Σ = 10 μm). While in the higher frequency (Σ = 0.5-μm) case, the ratio of $P_{cross-fire}/P_{end-fire}$ is reduced to 2.0. For branched-chain structures, the ratio of $P_{cross-fire}/P_{end-fire}$ decreased with the increase in the number of the side branches. These observations show that the frequency, polarization, and structure factors play important roles in determining the optical characteristics of branched chains of aerosol particles.

5002 Chemicals Monitoring and Transport

Refer also to citation(s) 37921, 37922, 37925, 38286, 38947, 39144, 39145

39110 (BNL–42744) **Climate regulation by marine phytoplankton?: A test by anthropogenic SOsub 2 emissions.** Schwartz, S.E. Brookhaven National Lab., Upton, NY (USA). May 1989. 6p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8906154–1: 28. Liege international astrophysical colloquium on our changing atmosphere, Liege, Belgium, 26-30 Jun 1989). Order Number DE89014708/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The potential sensitivity of global mean albedo and temperature to N prompted a novel suggestion consistent with the Gaia hypothesis for regulation of global climate by marine phytoplankton. Certain species of coccolithophores excrete dimethylsulfide (DMS), and this DMS is arguably the principal source of reduced sulfur gases in the global atmosphere and, in the absence of anthropogenic SO_2, the principal source of atmospheric gaseous sulfur species. Such gaseous sulfur species are oxidized in the atmosphere to form sulfuric acid, which rapidly forms an aerosol. Since sulfate-containing AP are highly efficient CCN, it is argued that an increase in DMS production by marine phytoplankton would yield increased concentrations of CCN, resulting in increased cloud albedo, decreased surface insolation, and decreased planetary temperature. It is further hypothesized that such decreased insolation or temperature might result in decreased production of DMS by marine phytoplankton, i.e., that the process might constitute a negative feedback loop for regulation of planetary climate by marine microorganisms. 18 refs., 3 figs., 1 tab.

39111 (CONF-890692–17) **Will air quality needs force the development of a market for alternative transportation fuels?.** McNutt, B.; Mintz, M.M. Argonne National Lab., IL (USA). 1989. 14p. Sponsored by DOE Management & Administration. DOE Contract W-31109-ENG-38. From 82. Air and Waste Management Association annual meeting and exhibition; Anaheim, CA (USA); 25-30 Jun 1989. Order Number DE89015131/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In response to these calculations, DOE has undertaken a technical assessment of the costs and benefits of developing a flexible-fuel transportation system – one that could switch between petroleum and an alternative fuel depending on price and availability. The supply analysis is addressing such issues as: where various alternative energy supplies for vehicles could come from, how large a share of the US transportation market those supplies might satisfy, what might a substantial shift to alternative fuels cost, and the relative security of new energy sources vis a vis conventional oil supplies. Concurrent with this activity, the infrastructure (or fuel distribution and vehicle supply) analysis is addressing such issues as: what might the necessary fuel distribution system cost, what are the likely cost and performance characteristics of mass-produced alternative-fuel vehicles, what level of market penetration is likely in the absence of specific government incentives, and how much petroleum might such penetration displace. Likewise, the environmental analysis is examining potential environmental, health and safety constraints, and estimating net environmental benefits associated with particular scenarios of market penetration and petroleum displacement. 4 refs., 3 figs., 1 tab.

39112 (CONF-8907104–1) **Assessment of global coastal hazards from sea level rise.** Gornitz, V.; Kanciruk, P. Oak Ridge National Lab., TN (USA). 1989. 15p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From 6. symposium on coastal and ocean management; Charleston, SC (USA); 11-14 Jul 1989. Order Number DE89014077/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A global coastal hazards data base that contains topographic, geologic, geomorphic, erosional and subsidence information is being developed in order to predict the coastal segments at greatest risk to a rise in sea level caused by future climate warming. High risk areas are characterized by low coastal relief, an erodible substrate, past and present evidence of subsidence, extensive shoreline retreat and high wave/tide energies. Data have been assembled for the USA and are being extended to the rest of North America. Several high risk areas have been tentatively identified and include the central Gulf Coast, South Florida, the North Carolina Outer Banks, southern Delmarva peninsula, and the San Francisco Bay area. 24 refs., 3 figs., 4 tabs.

39113 (DOE/ER/60485–2) **A research program on radiative, chemical, and dynamical feedback progresses influencing the carbon dioxide and trace gases climate effects: Annual progress report, September 1, 1986–July 15, 1989.** Atmospheric and Environmental Research, Inc., Cambridge, MA (USA). Jul 1989. 5p. Sponsored by DOE Energy Research. DOE Contract FG02-86ER60485. Order Number DE89015807/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This report summarizes the up-to-date progress. The program includes two tasks: atmospheric radiation and climatic effects and their objective is to link quantitatively the radiation forcing changes and the climate responses caused by increasing greenhouse gases. Here, the objective and approach are described. We investigate the combined atmospheric radiation characteristics of the greenhouse gases (H_2O, CO_2, CH_4, N_2O, CFCs, and O_3), aerosols and clouds. Since the climatic effect of increasing atmospheric greenhouse gases is initiated by perturabtion to the longwave thermal radiation, it is critical to understand better the radiation characteristics of the greenhouse gases and their relationship to radiatively-important aerosols and clouds; the latter reflect solar radiation (a cooling of the surface) and provide a greenhouse effect (a warming to the surface). Therefore, aerosol and cloud particles are an integral part of the radiation field in the atmosphere. 9 refs.

39114 (EC–E40-11/3-1988, pp. 203-228) **The PCB warehouse fire at St. Basile-le-Grand, Quebec.** Journeault, C. (Environment Quebec, PQ, Canada); Lapierre, F.; Perrier, R. Environment Canada, Ottawa, ON (Canada). 1988. (In French). (CONF-8810394–: 10. Canadian waste management conference, Winnipeg, Canada, 25-27 Oct 1988;MICROLOG–89-01998). In *Proceedings of*

the 10th Canadian waste management conference. Available from Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In August 1988, a warehouse in Quebec containing polychlorinated biphenyl wastes caught fire, sending hazardous combustion products into the environment and requiring evacuation of local residents. This paper summarizes the accident, the immediate reaction by fire fighters and environmental agencies, and the long term monitoring and cleanup efforts that have been carried out. A total of fifteen federal, provincial, municipal, private, and international bodies were involved in various programs related to coordination of resources, examination of health effects, environmental sampling, decontamination, communications, social support services, and interpretation of the results of environmental analyses. Environmental characterization was coordinated by Environment Canada, and highlights of these studies are presented. Results of analyses of PCBs, dioxins, and furans are included for a number of sites in the study area, in the soils and in the surface water and groundwater. Results indicate three zones of contamination: the site of the fire; a northern zone where passage of a plume left traces of contamination; and the rest of the evacuated zone which did not show significant contamination 12 days after the fire. An international panel of scientists made a series of recommendations on the return of evacuated populations, decontamination measures, continued environmental and epidemiological monitoring, and improved measures for response to similar accidents in the future. 2 figs., 4 tabs.

39115 (EML–504, pp. 22-59) **Measurements of the chemical composition of monthly samples of wet, dry, and bulk atmospheric deposition at Chester, NJ.** Feely, H.W. USDOE Environmental Measurements Lab., New York, NY (USA). Oct 1988. In *1985-86 biennial report of the EML regional baseline station at Chester, New Jersey.* Order Number DE89002705/JAW. Available from NTIS, PC A09/MF A01.

Samples of atmospheric deposition have been collected at the Chester site since October 1976. Open, high-walled plastic buckets have been used as bulk collectors to obtain monthly samples of integrated wet plus dry deposition. EML wet/dry collectors and Aerochem Metrics wet/dry collectors have been used to collect separate samples of precipitation and of dry deposition. From October 1976 until June 1982 monthly samples were collected and analyzed. In addition, sampling of individual precipitation events was begun in September 1978. Since July 1982, the data from such individual events have been used in place of monthly samples to determine the monthly values for the composition of precipitation at Chester. The deposition samples were measured for conductivity, pH, Na^+, K^+, Ca^{2+}, Mg^{2+}, NH_4^+, SO_4^{2-}, NO_3^-, Cl^-, HCO_3^-, and PO_4^{3-}. During the period from 1976 to 1981 some samples were also measured for Al, Fe, Pb, V, Mn, Ni, Cr, Zn, As, and Cd.

39116 (EML–504, pp. 60-130) **Measurements of the chemical composition of samples of individual or combined precipitation events at Chester, NJ.** Feely, H.W. USDOE Environmental Measurements Lab., New York, NY (USA). Oct 1988. In *1985-86 biennial report of the EML regional baseline station at Chester, New Jersey.* Order Number DE89002705/JAW. Available from NTIS, PC A09/MF A01.

The sampling of individual precipitation events at the Chester site was begun in September 1978 and has been continued until the present time. By an event we mean an essentially continuous single rain or snow storm, often involving a series of showers, and having a duration as short as an hour or less, or as long as a day or two. As a consequence, two or more rain storms are frequently included in a single sample. At times the sample has been changed much less frequently than is needed, and many samples include water from several precipitation events. These precipitation samples are typically stored at the site for a few days or weeks until they can be returned to the Laboratory. At EML, the samples are measured for their conductivity and pH. Subsequently, 250 mL portions of each sample have been sent to a contractor laboratory where they have been measured for conductivity, pH, Na^+, K^+, Ca^{2+}, Mg^{2+}, NH_4^+, So_4^{2-}, NO_3^-, Cl^-, NCO_3^-, and PO_4^{3-}.

39117 (LIS–82) **Benzene measurements in atmospheric air in the State of North-Rhine Westphalia.** Buck, M.; Ellermann, K. Landesanstalt fuer Immissionsschutz des Landes Nordrhein-Westfalen, Essen (Germany, F.R.). 1988. 70p. (In German). Available from Landesanstalt fuer Immissionsschutz des Landes Nordrhein-Westfalen, Essen (Germany, F.R.).

The results of benzene measurements in atmospheric air in 1980 to 1988 in the state of North-Rhine Westphalia are summarized. The measurements were taken in areas with various different emission sources as well as in the vicinity of specific sources at stations within the air quality monitoring network TEMES and at further sites in the Ruhr area. A wide range of concentrations was obtained. The mean annual concentration averaged over an area of 0,25 km^2 in rural setting remote from emission sources was found to be < 2 $\mu g/m^3$, while in the vicinity of coking plants concentrations ranged from 10 to 30 $\mu g/m^3$. Similar high concentrations (10 to 25 $\mu g/m^3$) were measured in inner cities with high traffic density. In the remaining areas where measurements were taken, such as urban residential areas, the vicinity of refineries and other industrialized zones as well as rural areas bordering industrialized urban centers, ambient benzene concentrations from < 2 to 30 $\mu g/m^3$ were recorded. At the measuring stations belonging to the air quality monitoring network TEMES annual average benzene concentrations of 4 to 17 $\mu g/m^3$ were obtained in 1987/88, while at further measuring sites in the Ruhr area the concentrations were between 5 and 23 $\mu g/m^3$. (orig./EF).

39118 (ORNL/FTR–3123) **Anthropogenic carbon dioxide experiments involved in 3-D modeling of ocean carbon cycle, Princeton, New Jersey, October 19–27, 1988: Foreign trip report.** Siegenthaler, U. Oak Ridge National Lab., TN (USA). 11 Nov 1988. 7p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89014065/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

U. Siegenthaler met with Drs. J.L. Sarmiento, J.R. Toggweiler, and other scientists at the Geophysical Fluid Dynamics Laboratory involved in three-dimensional (3-D) modeling of the oceanic carbon cycle. The first 3-D model simulation runs of the invasion of anthropogenic CO_2 into the ocean, to be carried out within the next several months in Princeton, were discussed. The following specifications of the model experiments were discussed and decided upon: type and resolution of dynamic ocean model to be used, the kind of CO_2 perturbation calculations, gas exchange formulation, and CO_2 chemistry formulation. The procedure for analysis of these first results was discussed, as well as the continuation of model experiments in a second stage. The work is conducted by the University of Bern (Dr. Ulrich Siegenthaler, Principal Investigator) for the Department of Energy's Energy Systems Program managed by Oak Ridge National Laboratory.

39119 (PB–89-164552/XAB) **HEGADAS: heavy gas dispersion model (for microcomputers). Model-Simulation.** Marsden, A.; Guinnup, D. Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards. 27 Jan 1989. vp. Available from NTISCP D99.

The software is contained on 5 1/4-inch diskettes, double density (360K), compatible with the IBM PC microcomputer. The diskettes are in the ASCII format. Price includes documentation, PB–89-164560.

The HEGADAS program models the dispersion of releases of heavier-than-air gases to the atmosphere. The model is an integral model which uses assumed profile (e.g., concentration profile) shapes and empirical relations describing air entrainment. The model provides for a smooth transition to passive dispersion. Descriptions of heat transfer from the ground and water vapor transfer are also included. The source release rate may be constant or time-dependent (e.g., evaporating liquid pool). Software Description: The software is written in the FORTRAN language for use on an IBM PC or compatible machines using DOS 3.1 or higher operating system. Memory requirement is 512K.

39120 (PNL–6933) **1986 wet deposition temporal and spatial patterns in North America.** Olsen, A.R. Pacific Northwest Lab., Richland, WA (USA). Jul 1989. 213p. Sponsored by DOE/ER;EPA. DOE Contract AC06-76RL01830. Order Number DE89014372/JAW. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

The focus of this report is on North American wet deposition temporal patterns from 1979 to 1986 and spatial patterns for 1986. The report provides statistical distribution summaries of annual precipitation-weighted average concentration and annual deposition for nine ion species: hydrogen, sulfate, nitrate, ammonium, calcium, chloride, sodium, potassium, and magnesium. The data in the report are from the Acid Depositing System (ADS) for the statistical reporting of North American deposition data. Isopleth maps, based on surface estimation using kriging, display concentration and deposition spatial patterns of pH, hydrogen, sulfate, nitrate, ammonium, and calcium ion species for 1986 annual, winter, and summer periods. The temporal pattern analyses use a subset of 30 sites over an 8-year (1979-1986) period and an expanded subset of 137 sites with greater spatial coverage over a 5-year (1982-1986) period. The 8-year period represents the longest period with wet deposition monitoring data unavailable that has a sufficient number of sites with data of known quality to allow a descriptive summary of annual temporal patterns. 19 refs., 105 figs., 29 tabs.

39121 (PNL-SA–17042) **Economic methods and applications for NAPAP's assessment reports.** Neese, R.J. Pacific Northwest Lab., Richland, WA (USA). Jun 1989. 15p. Sponsored by DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-890692–15: 82. Air and Waste Management Association annual meeting and exhibition, Anaheim, CA, USA, 25-30 Jun 1989). Order Number DE89014922/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In this paper, we review the role of economics in NAPAP. The paper explains the criteria NAPAP uses to assess whether quantification of the benefits of reduced acidic deposition will be attempted and the criteria for selecting a particular technique or model. Next, the paper reports NAPAP's plans for including economic information in its State-of-Science/Technology Reports and Integrated Assessment. The paper concludes with an overview of what we have already learned regarding integrating economics with a physical science research program. The desire to include economics in NAPAP Reports is due in large part to the kinds of information Congress mandated should be included in NAPAP's assessments. In general, these assessments provide information that decision makers in the executive and legislative branches of the federal government, the state government, and others, can use to make informed policy decisions regarding acid deposition. To determine the importance of the acid deposition problem, these decision makers require information about current and expected future impacts of acid deposition. To determine the appropriateness of a particular control policy, many decision makers desire information about both the total positive and negative impacts that such a policy will have on their constituents and the nation as a whole.

39122 (PNL-SA–17105) **Criteria for selecting a CO_2/climate change region of study.** Cushman, R.; Easterling, W.; Rosenberg, N.; Malone, T.; Edmonds, J.; Scott, M.; Stoke, G. Pacific Northwest Lab., Richland, WA (USA). 1989. 14p. Sponsored by DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-890692–14: 82. Air and Waste Management Association annual meeting and exhibition, Anaheim, CA, USA, 25-30 Jun 1989). Order Number DE89014927/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This effort has three near-term goals: (1) to develop robust methods of analysis including the analysis of uncertainty; (2) to develop information systems to support CO_2/climate change analysis; and (3) to develop channels of communication among researchers and between researchers and parties potentially affected by CO_2/climate change. Initially, the program will focus on a single region of the United States, employ a historical analog climate, and analyze the interactions of all of the resources resident within that region as they might evolve under current conditions and under evolving CO_2/climate change over the next 50 years. Five elements of the program will address the issues of: Analysis, Information Systems, Uncertainty, Knowledge Transfer, and Coordination. This paper will give special attention to the analytical framework and in particular to the criteria for selecting a region for study. 19 refs., 2 figs.

39123 (SAND–88-1085) **Stage response of an Andersen cascade impactor to monodisperse droplets.** Rader, D.J.; Mondy, L.A.; Brockmann, J.E.; Lucero, D.A. Sandia National Labs., Albuquerque, NM (USA). May 1989. 23p. Sponsored by DOE Energy Research. DOE Contract AC04-76DP00789. Order Number DE89014398/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Stage responses for an Andersen Mark III cascade impactor have been experimentally determined using monodisperse oil droplets. The impactor was operated upright and fully assembled so that interstage interference and wall losses could be properly studied. Interstage losses reached a maximum of about 15% for particle aerodynamic diameters of about 10 μm. The observed stage responses, defines as the fraction of particles entering the impactor that are collected on a stage, showed maxima that fell significantly short of unity (as low as 0.6). Physically, maxima less than unity indicate that a monodisperse aerosol is never collected exclusively on one stage, but is distributed among several stages and internal losses. Correlations for the stage responses are presented so that the experimental results can be used to determine size distributions with available data-inversion algorithms. One potential application of this technique is the characterization of droplet clouds generated by explosive events. 21 refs., 4 figs., 2 tabs.

39124 (UCRL–50007-87, pp. 34-41) **Measurements and predictions of effluent dilution from a tall laboratory stack.** Wong, M.K. Lawrence Livermore National Lab., CA (USA). Jul 1988. In *Hazards Control Department annual technology review, 1987.* Order Number DE89002470/JAW. Available from NTIS, PC A07/MF A01.

Actual field measurements of downwind ground-level effluent concentrations were compared with the concentrations predicted by two calculational methods - Gaussian-plum dispersion and Wilson's design procedure. These are theoretical and empirical methods for the prediction of downwind-effluent concentration from a tall exhaust stack. Generally, these methods apply to the relatively simple case of a single building without surrounding obstructions and on level terrain. The Gaussian-plume dispersion method is applicable for predicting concentrations at distances greater than 100 m from the stack; Wilson's estimate is for predicting concentration on the roof or a short distance from the stack. It was found that Gaussian plum calculations result in higher-than-measured concentrations. Wilson's design procedure yields good agreement with experimental data. 5 references, 3 figures, 2 tables.

39125 (UCRL–50007-87, pp. 66-70) **Study of the performance of an air sampler for biological agents.** Biermann, A.H.; Kwan, J.K. Lawrence Livermore National Lab., CA (USA). Jul 1988. In *Hazards Control Department annual technology review, 1987.* Order Number DE89002470/JAW. Available from NTIS, PC A07/MF A01.

In recent years airborne-microbe samplers have been developed to offer improvements over the size, weight, portability, and sample-rate limitations of the traditional Andersen cascade-impactor air sampler. The authors investigated the collection efficiency of the Biotest air sampler for aerosols and for particle losses within the sampler itself. Results indicate that aerosol concentrations as measured with the Biotest sampler can underestimate the actual concentration at smaller particle sizes (1.5-3mm). This may be attributed to the decrease in collection efficiency of the device. While the sampler's efficiency increases for larger particles, it was found that the great majority of these particles collected on the fan blades of the sampler rather than on the collection strip. Although its higher sample rate is advantageous, the Biotest sampler does not allow simple quantitative interpretation of aerosol concentration measurements. 2 references, 4 figures.

39126 (UCRL–50007-87, pp. 71-78) **Aerosol sampling losses in transport lines.** Biermann, A.H. Lawrence Livermore National Lab., CA (USA). Jul 1988. In *Hazards Control Department annual technology review, 1987.* Order Number DE89002470/JAW. Available from NTIS, PC A07/MF A01.

Particle losses may occur in transport lines used to sample aerosols. If the losses are significant, the aerosol sampler or detector will underestimate the real aerosol concentration of the source volume. Some of the mechanisms causing particle losses include diffusion, sedimentation, and inertia. Theoretical models predicting losses by these mechanisms under turbulent flow conditions are considered. For a typical transport line with a 0.953-cm diameter and a volumetric flow of 40 lpm, expected losses can be larger than

10% for particles greater than 2 μm in diameter and with densities greater than 7.28 g/cm^3. Losses in a single 90° bend can be equally as large.

39127 (UCRL–99592) **Multimedia transport of organic contaminants and exposure modeling.** Layton, D.W.; McKone, T.E. Lawrence Livermore National Lab., CA (USA). 1988. 23p. Sponsored by DOE Energy Research. DOE Contract W-7405-ENG-48. (CONF-8811128–2: 18. conference on toxicology, Fairborn, OH, USA, 1-3 Nov 1988). Order Number DE89015451/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Human exposures to organic contaminants in the environment are a complex function of human factors, physicochemical properties of the contaminants, and characteristics of the environmental media in which the contaminants reside. One subject of interest in the screening of organic chemicals for the purpose of identifying exposure pathways of potential concern is the relationship between exposures and contaminant properties. To study such relationships, a multimedia environmental model termed GEOTOX is used to predict the equilibrium partitioning and transport of "reference" organic chemicals between compartments representing different media (i.e., soil layers, ground water, air, biota, etc.) of a contaminated landscape. Reference chemicals, which are added to the surface soil of a landscape, are defined by properties consisting of the Henry's law constant, soil water-soil organic carbon partition coefficient, and bioconcentration factors. The steady-state concentrations of the chemical in the GEOTOX compartments are then used to estimate lifetime exposures (in mg/kg-d) to the compartments for individuals living in the contaminated landscape. Exposure pathways addressed include ingestion, inhalation, and dermal absorption. Local sensitivity analyses are performed to determine which chemical and landscape properties have the greatest effect on the exposure estimates. 9 refs., 4 figs., 3 tabs.

39128 Perspective on dioxin emissions from municipal solid waste incinerators. Travis, C.C. (Oak Ridge National Lab., TN (USA)); Hattemer-Frey, H.A. *Risk Analysis (USA),* 9(1): 91-97 (Mar 1989).

This paper discusses the following key issues concerning human exposure to dioxins and furans emitted from typical, modern MSW incinerators: (1) Are MSW incinerators the major source of PCDD/PCDF input into the environment? (2) Are environmental concentrations around MSW incinerators substantially elevated relative to background levels? And (3) are MSW incinerators the major source of human exposure to PCDDs and PCDFs? Current scientific evidence indicates that (1) combustion sources in general (including steel mills, copper smelting plants, motor vehicles, pulp and paper mills, and MSW incinerators) are major sources of PCDD/PCDF input in the environment; (2) environmental concentrations of PCDDs and PCDFs around operating MSW incinerators are not substantially elevated; and (3) 99% of human exposure to PCDDs and PCDFs is from background contamination, even for individuals living near a modern MSW incinerator.

39129 Antarctic atmospheric tracer experiments. Mroz, E. J. (Isotope Geochemistry Group, Los Alamos National Laboratory, Los Alamos, New Mexico (US)); Alei, M.; Cappis, J. H.; Guthals, P. R.; Mason, A. S.; Rokop, D. J. *Journal of Geophysical Research (USA),* 94(D6): 8577-8583 (20 Jun 1989).

Although the Antarctic circulation cell is a statistical construct, its ability to transport trace gases and aerosols to the continent has been discerned experimentally by the use of deuterated methane atmospheric tracers. Atmospheric tracer experiments were conducted in 1984 to study transport from the mid-latitudes of the southern hemisphere to Antarctica. The tracer was transported to the polar plateau within a few days following tracer releases that took place in the summer and spring. However, in winter, poleward transport of the tracer was inhibited by the winter circumpolar vortex. The tracer concentration pattern was consistent with a "lumpy streaky" distribution produced by a numerical model of global circulation. © American Geophysical Union 1989

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Refer also to citation(s) 38432, 38454, 39152, 39326, 39347, 39577

39130 (BALUF-STS–87-8) **Radiocesium in Austrian precipitation samples after Chernobyl.** Henrich, E.; Weisz, J.; Zapletal, M.; Friedrich, M.; Haider, W. Bundesanstalt fuer Lebensmitteluntersuchung und -forschung, Vienna (Austria). 1987. 10p. Order Number DE89631125/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Measured rain samples' contaminations, taken by the Austrian System for the measurement of Environmental Radioactivity, as from May 1986 and April 1986 are presented in maps and tables. The very narrow local pattern of the deposition of Chernobyl-fallout inside the Alpine valleys, caused by irregular weather conditions, can be seen very clearly, with values differing by a factor of up to 30 within a few kilometres. Maximum values reach up to more than 150 kBq Cs-137/m^2, whereas the average values are in the range of tens of kBq/m^2. In spite of the very different location of the samplers in the two systems, the ones of the ASMER being situated in or near larger communities, the others located in small villages in Alpine valleys, with the exception of Carinthia and Vorarlberg the average values are remarkably similar. This seems to justify the use of the ASMER-data for dose assessment studies, especially if taking into account the population distribution and associated weighting factors. 1 ref., 6 figs., 1 tab. (qui).

39131 (BALUF-STS-AERO–88) **Valuating report on radionuclide concentrations in aerosols in 1988.** Henrich, E.; Friedrich, M.; Haider, W. Bundesanstalt fuer Lebensmitteluntersuchung und -forschung, Vienna (Austria). Mar 1989. 36p. (In German). Order Number DE89631123/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Sample preparation - and measuring methods and results on aerosol samples from the Austrian Environment Radioactivity Monitoring Network are presented. Special emphasis is on Cs-134, Cs-137 (Chernobyl fallout) and I-131 from medical applications. Comparisons with 1987 are made. The lung doses for the population are estimated to be 0,5 - 5 nSv, i.e. very small. 8 refs., 15 figs., 11 tabs. (qui).

39132 (BALUF-STS-NDH3–88) **Valuating report on tritium in precipitation samples 1988.** Henrich, E.; Weisz, J.; Haider, W. Bundesanstalt fuer Lebensmitteluntersuchung und -forschung, Vienna (Austria). Feb 1989. 17p. (In German). Order Number DE89631124/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Sample preparation - and measuring methods and results on precipitation samples from the Austrian Environment Radioactivity Monitoring Network, for 1988 are presented. The radiation burden to the population from ingestion is estimated to be 51 nSv for adults and 63 nSv for one-year-old children, as compared to 2000000 nSv of the natural radiation burden in Austria. 10 refs., 5 figs., 4 tabs. (qui).

39133 (EML–504, pp. 1-16) **Measurements of radioactivity in filter samples of surface air at Chester, NJ.** Larsen, R.J.; Feely, H.W.; Sanderson, C.G. USDOE Environmental Measurements Lab., New York, NY (USA). Oct 1988. In *1985-86 biennial report of the EML regional baseline station at Chester, New Jersey.* Order Number DE89002705/JAW. Available from NTIS, PC A09/MF A01.

Filter samples of surface air have been collected at the Chester site as part of the EML Surface Air Sampling Program (SASP) since October 1976. The filters from this site, together with the filters from other sites which are sampled as part of the SASP are analyzed for their content of several radio-nuclides. The resulting data on the atmospheric concentration of radioactivity from nuclear weapons tests, nuclear related events, such as the Chernobyl reactor accident, and of certain natural radionuclides are used t o study processes of atmospheric transport and dispersion.

39134 (EML–504, pp. 131-141) **Environmental radiation monitoring.** Miller, K.M.; Gulbin, J.F. USDOE Environmental Measurements Lab., New York, NY (USA). Oct 1988. In *1985-86 biennial report of the EML regional baseline station at Chester, New*

Jersey. Order Number DE89002705/JAW. Available from NTIS, PC A09/MF A01.

The penetrating component (gamma and secondary cosmic) of the environmental radiation field is studied at Chester, NJ using pressurized ionization chambers (PIC), Lithium fluoride (LIF) thermoluminescent dosimeters (TLD), and germanium (Ge) gamma-ray spectrometers. A main and a back-up PIC spaced several feet apart record the exposure rate every 10 sec on a magnetic tape cassette. Two TLD packets containing a total of 15 chips are used to provide an independent integrated monthly exposure. Germanium detectors are used to occasionally check the gamma emitting radionuclide composition in the soil via in situ spectrometry and/or laboratory-based counting of collected samples. A continuous record of exposure rates exists for this site starting from October 1976. These data are used in the study of temporal variations in natural background radiation and also serve to document any regional perturbations in the radiation environment due to man's activities.

39135 (EML–504, pp. 142-152) **Radon-222 measurement at Chester, NJ through July 1986.** Fisenne, I.M. USDOE Environmental Measurements Lab., New York, NY (USA). Oct 1988. In *1985-86 biennial report of the EML regional baseline station at Chester, New Jersey*. Order Number DE89002705/JAW. Available from NTIS, PC A09/MF A01.

The Environmental Measurements Laboratory (EML) has completed 9 y or continuous hourly ^{222}Ra measurements at the Chester, NJ Regional Baseline Station. The 9 y of continuous radon concentration measurements at Chester, NJ are to our knowledge the largest database of outdoor radon measurements for a single site. Besides affording the opportunity to study long-term trends in atmospheric radon concentrations, these measurements are of value to other research programs at Chester, as well as concurrent programs based in the New York City area. In addition, the continuous radon monitor has been useful as an experimental system for testing new techniques for maintaining and acquiring data from remote field sites.

39136 (EUR–11821) **Environmental radioactivity Ispra 1987.** Dominici, G. Commission of the European Communities, Luxembourg (Luxembourg). 1988. 50p. (In Italian). Available from NTIS (US Sales Only), PC A03/MF A01.

In this report there are briefly described the measurements of environmental radioactivity performed during 1987 by the site survey group of the Radioprotection Division at the Joint Research Centre Ispra Establishment. Data are given on the concentrations of Sr-90, Cs-137, and other radionuclides in precipitation, air, waters, herbage, milk and radioactive effluents. The environmental contamination is mainly a consequence of the nuclear accident of Chernobyl.

39137 (EUR–11870) **Report on the results of the third intercomparison study of thermoluminescent dosimeters for environmental measurements.** Driscoll, C.M.H. Commission of the European Communities, Luxembourg (Luxembourg). 1988. 39p. Available from NTIS (US Sales Only), PC A03/MF A01.

Scientific laboratories within the Member States of the European Communities have a continuing interest in the use and development of both thermoluminescent dosimeters and thermoluminescence measurement techniques for the assessment of exposure from environmental gamma radiation. In the United Kingdom, for example, environmental thermoluminescent dosimeters have been developed by the National Radiological Protection Board (NRPB) and used in a national survey of indoor radiation exposure. Other laboratories in various Member States are currently involved in similar studies of natural radiation exposure or are using thermoluminescent dosimeters for environmental measurements at reactor sites. Therefore, it is appropriate that such laboratories have facilities within the European Community for standardization and intercomparison of their environmental measurement techniques.

39138 (EUR–11882) **Results of the third CEC intercomparison of active and passive detectors for the measurement of radon and radon decay products.** Miles, J.C.H.; Sinnaeve, J. Commission of the European Communities, Luxembourg (Luxembourg). 1988. 77p. Available from NTIS (US Sales Only), PC A05/MF A01.

In 1982 and 1984 the radiation protection research programme of the European Communities organized intercomparisons of radon and radon daughter measurement techniques, and the results were published Miles et al., 1983; Miles and Sinnaeve, 1986. The second of these intercomparisons was carried out as part of a wider exercise sponsored jointly by the CEC and the OECD/NEA (OECD, 1983). The third CEC intercomparison, held at the National Radiological Protection Board (NRPB) in the United Kingdom in 1987, again constituted the European regional part of this wider exercise. The intercomparison on the European region was carried out in two stages, the first for passive integrating detectors and the second for active instruments, usually by spot measurements. Twenty-one laboratories participated in the intercomparison, of passive dosimetry and 17 in that for active dosimetry. Passive detectors have been used in many European countries to carry out surveys of exposure in homes and to monitor occupational exposure. The exposures for the intercomparison of passive detectors were carried out in June, July and August 1987 at NRPB. The intercomparison of active detectors was carried out over three days in October 1987, when scientists from the participating laboratories brought their equipment to NRPB.

39139 (INIS-mf–11440, pp. 594-595) **Solutions for Rn-222 and Rn-220 diffusion equation in atmosphere.** Cuculeanu, V. (Institutul de Meteorologie si Hidrologie, Bucharest, Romania); Sonoc, S. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics*. Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Two methods, one numerical based on improved central difference scheme and another semi- analytical are presented. (authors).

39140 (INIS-mf–11457(v.1,2) v. 1) **Radon and radon daughter concentrations over an extended uranium ore body.** O'Brien, R.S. (Australian Radiation Lab., Melbourne (Australia)); Solomon, S.B.; Lokan, K.H.; Gan, T.H.; Martin, L.J.; Wise, K.N.; Leach, V.A. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes)*. Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

An instrumented tower has been erected over an extended uranium ore deposit at Yeelirrie, Western Australia to study on a long term basis the dispersion of radon/radon daughters as a function of the atmospheric conditions. In particular, the rapid build-up of radon and its daughters during nocturnal inversion conditions is being studied. Results to date show this build-up to be strongly dependent on the vertical profiles of both temperature and horizontal wind speed. 5 figures, 1 table.

39141 (INIS-mf–11457(v.1,2) v. 2) **Thermophoretic collection of radon daughters.** Leung, H. (Toronto Univ., ON (Canada). Dept. of Chemical Engineering and Applied Chemistry); Phillips, C.R. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes)*. Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The mechanism of thermophoresis is applied to the collection of radon daughters through the use of a constant temperature gradient across two parallel discs. Collected radon daughter activity was found to be linear with temperature gradient at a constant Working Level and also linear with Working Level at a constant temperature gradient, thereby allowing a constant conversion factor (dpm/(degrees Celcius/cm) WL) for thermophoretic collection to be used. Under laboratory conditions, a thermophoretic dosimeter with a temperature gradient of about 400 degrees Celcius/cm has a collection efficiency about the same as a CEA (Commissariat a l'Energie Atomique) pump-driven dosimeter (0.05 L/min). Because a diffusion barrier is needed to serve as a shield against external wind effects,

the temperature gradient applied in practice may have to be substantially greater.

39142 (INIS-mf–11480, pp. 35-36) **Radionuclides in cultivated soils.** Meisel, S.; Graller, P.; Kahr, G.; Ninaus, W.; Mueller, H. Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik. Nov 1988. (In German). In *Annual report of the Institute for Theoretical Physics in Graz, Austria.* Order Number DE89631627/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

CHERNOBYLSK-4 REACTOR/fallout; RADIONUCLIDE MIGRATION/mathematical models; SOILS/contamination; AUSTRIA; CESIUM 137; FALLOUT; PROGRESS REPORT; SAMPLE PREPARATION; SOILS; CONTAMINATION

39143 (KNMI–173) **Working document dispersion models.** Dop, H. van (Koninklijk Nederlands Meteorologisch Inst., De Bilt (Netherlands)) (ed.); KNMI-RIVM collaboration. Koninklijk Nederlands Meteorologisch Inst., De Bilt (Netherlands). 1988. 101p. (In Dutch). Order Number DE89631128/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

This report is a summary of the most important results from June 1985 of the collaboration of the RIVM (Dutch National Institute for Public Health and Environment Hygiene) and KNMI (Royal Dutch Meteorologic Institute) on the domain of dispersion models. It contains a short description of the actual SO_x/NO_x-model. Furthermore it contains recommendations for modifications of some numerical-mathematical aspects and an impulse to a more complete description of chemical processes in the atmosphere and the (wet) deposition process. A separate chapter is devoted to the preparation of meteorologic data which are relevant for dispersion as well as atmospheric chemistry and deposition. This report serves as working document for the final formulation of a acidifying- and oxidant-model. (H.W.). 69 refs.; 51 figs.; 13 tabs.; 3 schemes.

39144 (RFP–4333-Vol.1) **Results of a tracer study for the validation study: The Terrain-Responsive Atmospheric Code (TRAC): Volume 1, Final report.** Wilkerson, G.W.; Porter, R.G.; Brown, K.J. Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant; North American Weather Consultants, Salt Lake City, UT (USA). Sep 1988. 479p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP03533. Order Number DE89014965/JAW. Available from NTIS, PC A21/MF A01 - OSTI.

This report describes a tracer study conducted by North American Weather Consultants (NAWC) at the Rocky Flats Plant in Colorado. The purpose of the study was to provide data for the evaluation of a dispersion model. This tracer study was timed to sample the upslope, downslope and transition conditions prevalent in the Rocky Flats area during the summer period. The field studies were conducted from 17 July, 1987 through 8 August, 1987. A total of twelve days of plume tracking were conducted, four during upslope conditions, six during stable downslope conditions, and two during transition conditions. The tracer gas, sulfur hexafluoride (SF_6) was released on the Rocky Flats plant site and the plume was tracked using an aircraft with a continuous SF_6 analyzer on-board. Grab samples were also obtained from various sites on the ground during the aerial tracking period.

39145 (RFP–4333-Vol.2) **Results of a tracer study for the validation study: The Terrain-Responsive Atmospheric Code (TRAC): Volume 2.** Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant; North American Weather Consultants, Salt Lake City, UT (USA). Sep 1988. 344p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP03533. Order Number DE89014966/JAW. Available from NTIS, PC A15/MF A01 - OSTI; GPO Dep.

This report describes a tracer study conducted by North American Weather Consultants (NAWC) at the Rocky Flats Plant in Colorado. The purpose of the study was to provide data for the evaluation of a dispersion model. This tracer study was timed to sample the upslope, downslope and transition conditions prevalent in the Rocky Flats area during the summer period. The field studies were conducted from 17 July, 1987 through 8 August, 1987. A total of twelve days of plume tracking were conducted, four during upslope conditions, six during stable downslope conditions, and two during transition conditions. The tracer gas, sulfur hexafluoride (SF_6) was released on the Rocky Flats plant site and the plume was tracked using an aircraft with a continuous SF_6 analyzer on-board. Grab samples were also obtained from various sites on the ground during the aerial tracking period. Volume 2 contains data sheets only.

39146 (UCRL–50007-87, pp. 1-13) **Summary of the Bikini Atoll ionizing-radiation survey.** Shingleton, K.L.; Cate, J.L.; Trent, M.G.; Robison, W.L. Lawrence Livermore National Lab., CA (USA). Jul 1988. In *Hazards Control Department annual technology review, 1987.* Order Number DE89002470/JAW. Available from NTIS, PC A07/MF A01.

This survey was designed to measure the beta dose rate from ^{137}Cs and $^{90}Sr/^{90}Y$ relative to previously measured gamma dose rates on Bikini and Eneu Islands. The authors exposed modified Panasonic-802 thermoluminescent dosimeters (TLDs) in over 100 sites for six months to accomplish this task. The sites were selected to be either in areas of known high gamma dose rates, in areas where the Marshallese would likely spend most of their time upon resettlement, or in areas where experimental environmental changes has been made. Therefore, the beta and gamma does rates do not represent island averages. The mean beta dose rate on Enue ranged from 23 mrem/yr at 1 cm to 6 mrem/yr at 100 cm, as compared with a mean deep dose rate of 17.5 mrem/yr. The mean beta dose rate around houses and in general area on Bikini ranged from 425 mrem/yr at 1 cm to 178 mrem/yr at 100 cm, compared with a deep dose rate of about 154 mrem/yr. Because monitoring sites were specifically placed in the most-contaminated areas of Bikini and Eneu, the unshielded beta dose rates reported provide an upper limit of radiation dose;actual doses received by the Bikinians would be reduced significantly by clothing, footwear, and ground cover such as crushed coral, which reduces the beta dose rate by 80-90%. The amount of time spent in houses and in the minimally contaminated areas around houses and the lagoon would further reduce the beta dose rates reported here. 17 referenced, 12 figures, 1 table.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

Refer also to citation(s) 39148

39147 (JINR-E–14-88-583) **SANS studies of fractal properties of apatite-carbonate rocks.** Gordelij, V.I. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics. 1988. 3p. Order Number DE89631089/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to Institut Laue-Langevin, France.

Research proposal of the study of mineral component fractal properties at D11 installation of ILL, Grenoble, France is presented. The aim of the SANS experiment is to determine the mineral surface fractal dimension in the region of $10^{-3} \leq q \leq 10^{-1}$ A^{-1}. The scaling treatment in a wide range of q would be of basis importance for the determination of surface fractal properties and for constructing a theory of elementary act of heterocoagulation between the mineral particle and the gas bubble. 4 refs.

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Refer also to citation(s) 38126, 38169, 39114, 39161

39148 (CONF-880385–2) **New dimensions from statistical graphics for GIS [geographic information system] analysis and interpretation.** McCord, R.A.; Olson, R.J. Oak Ridge National Lab., TN (USA). 1988. 10p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From 8. ESRI annual user conference; Palm Springs, CA, USA; 21-25 Mar 1988. Order Number DE89012339/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Environmental research and assessment activities at Oak Ridge National Laboratory (ORNL) include the analysis of spatial and temporal patterns of ecosystem response at a landscape scale.

Analysis through use of geographic information system (GIS) involves an interaction between the user and thematic data sets frequently expressed as maps. A portion of GIS analysis has a mathematical or statistical aspect, especially for the analysis of temporal patterns. ARC/INFO is an excellent tool for manipulating GIS data and producing the appropriate map graphics. INFO also has some limited ability to produce statistical tabulation. At ORNL we have extended our capabilities by graphically interfacing ARC/INFO and SAS/GRAPH to provide a combined mapping and statistical graphics environment. With the data management, statistical, and graphics capabilities of SAS added to ARC/INFO, we have expanded the analytical and graphical dimensions of the GIS environment. Pie or bar charts, frequency curves, hydrographs, or scatter plots as produced by SAS can be added to maps from attribute data associated with ARC/INFO coverages. Numerous, small, simplified graphs can also become a source of complex map "symbols." These additions extend the dimensions of GIS graphics to include time, details of the thematic composition, distribution, and interrelationships. 7 refs., 3 figs.

39149 (EC–E40-11/3-1988, pp. 245-252) **Clean-up of the old Lasalle landfill site.** Goulet, S. (Ministere de l'Environnement du Quebec, PQ, Canada). Environment Canada, Ottawa, ON (Canada). 1988. (CONF-8810394–: 10. Canadian waste management conference, Winnipeg, Canada, 25-27 Oct 1988;MICROLOG–89-01998). In *Proceedings of the 10th Canadian waste management conference.* Available from Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The municipal waste landfill at Lasalle, Quebec was also used for industrial wastes until its closure in 1960. Afterwards, part of the site was used for residential development. Investigations were initiated to examine the extent of contamination of the site, and to restore the contaminated part of the site if necessary. Characterization of the soils, ground water, and indoor air indicated that the principal toxic contaminants in the soil were polycyclic aromatic hydrocarbons, polychlorinated biphenyls, and monocyclic aromatic hydrocarbons. Some dioxins, furans, and heavy metals were also encountered. The results of these studies showed no evidence for exposure of the contaminants to the population, but concern for possible long term effects led to a number of responses. Restoration of the landfill site was undertaken in a 10-week program in 1986. The site was closed to prevent dust exposure, and mobile monitoring of air pollution was carried out. Restoration procedures included excavation of contaminated soils, demolition of eight housing units, and collection and decontamination of ground water. A special site was constructed for storing the excavated soils. 3 refs., 2 figs., 1 tab.

39150 (ORNL/FTR–3002) **[Assessment of compliance with environmental regulations, Sondrestrom AB and Thule AB, Greenland, July 13–29, 1988]: Foreign trip report.** Eddlemon, G.K.; Sigal, L.L.; Brown, K.J.; Jolley, R.L.; Singh, S.P.; Hunsaker, D.B.; Tiechert, W.P. Oak Ridge National Lab., TN (USA). 22 Aug 1988. 11p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89014055/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Seven members of a ORNL team visited Sondrestrom and Thule Air Bases to conduct ECAMP assessments for Headquarters Air Force Space Command. Reports were written evaluating compliance with federal, Air Force, and local environmental regulations in the following areas: air emissions; wastewater discharges, solid waste management; polychlorinated biphenyl (PCB) management, drinking water; petroleum, oils, and lubricants (POL) management; hazardous materials management; and natural and historic resources. In addition, site management plans were evaluated, and information was gathered for revision of the plans, if need be, by staff in the Environmental Sciences Division, ORNL. 2 refs.

39151 (PNL–6826) **Regulatory standards and other guidelines for goundwater monitoring programs.** Keller, J.F.; Schmidt, A.J.; Selby, K.B. Pacific Northwest Lab., Richland, WA (USA). Jul 1989. 132p. Sponsored by DOE Environment Health & Safety. DOE Contract AC06-76RL01830. Order Number DE89014323/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

This report has been prepared to provide information on regulatory programs relevant to a groundwater monitoring program. The information provides a framework within which planners and decisions makers can systematically consider the maze of specific requirements and guidance as they develop a groundwater strategy for the Hanford Site. Although this report discusses legislation and regulations as they pertain to groundwater monitoring activities, it is not intended as a legal opinion. Rather, it is provided as a guide to the relationships among the various regulatory programs related to groundwater. Federal and state environmental pollution control statutes and regulations that have been reviewed in this document include the Resource Conservation and Recovery Act (RCRA); Washington's Hazardous Waste Management Act; Washington's Solid Waste Management Act; the Comprehensive Environmental Response, Liability, and Compensation Act (CERCLA); the Superfund Amendments and Reauthorization Act (SARA); the Safe Drinking Water Act (SDWA); and the Clean Water Act (CWA). The implications and details of these regulations as they may apply to Hanford are discussed. The information contained within this report can be used to develop the Hanford Site's groundwater quality protection programs, assess regulatory compliance, and characterize the Hanford Site for potential remediation and corrective actions. 5 refs., 14 tabs.

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Refer also to citation(s) 38126, 38127, 38169, 38208, 38209, 38403, 38416, 38454, 38867, 39134, 39136, 39334, 39349

39152 (BALUF-RuR–88-1) **Soil contamination in Northern Austria as aftermath of the Chernobyl reactor accident.** Schoenhofer, F.; Friedrich, M. Bundesanstalt fuer Lebensmitteluntersuchung und -forschung, Vienna (Austria). 1988. 8p. (In German). Order Number DE89631080/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The soil contamination caused by the accident at Chernobyl was very uneven distributed in Austria. In late autumn 1986 soil samples from northern Austria were analysed in order to get to know the actual contamination in terms of figures. The extreme values for Cs-137 found were 962 and 73630 Bq/m^2 respectively. 3 refs., 2 figs.

39153 (BALUF-STS–88-01) **Cs-137 in natural ecological systems. Description of the situation in a high contamination area in Austria after Chernobyl.** Henrich, E.; Weisz, J.; Zapletal, M.; Friedrich, M.; Haider, W. Bundesanstalt fuer Lebensmitteluntersuchung und -forschung, Vienna (Austria). 1988. 9p. Order Number DE89631226/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

A small area near the border of the two provinces Lower Austria - Upper Austria from a region with the highest Chernobyl fallout was selected for radioactivity monitoring beginning in 1986 and continuing into 1987. This is thought to be a model of a forest ecosystem. Values of cesium 137 concentration in soils, moss, spruce and pine, and in fungi are given in tables, referring to 30 Aug 1987. 2 refs., 7 figs., 3 tabs. (qui).

39154 (BALUF-STS–88-04) **Rating of cesium contamination of wild mushrooms.** Henrich, E.; Zapletal, M.; Friedrich, M.; Haider, W. Bundesanstalt fuer Lebensmitteluntersuchung und -forschung, Vienna (Austria). Aug 1988. 11p. (In German). Order Number DE89631227/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

'Rating' means here a 5-fold scale with the ranges: more than 100 nCi/kg raw weight - 'very high'; 300 - 100; 3 - 30; 1 - 3; less than 1 nCi/kg - 'very low'. A list of some 50 - 60 different kinds of mushrooms are listed and evaluated in this scale, as from 1988 and from a region with a high Chernobyl fallout. As a comparison, contamination values of 12 mushroom sorts from before the Chernobyl accident, coming from atmospheric nuclear weapons tests, are also given. 2 figs., 5 tabs. (qui).

39155 (BNL–42394) **Environmental measurements during the TMI-2 accident.** Hull, A.P. Brookhaven National Lab., Upton, NY (USA). 1988. 28p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-881024–15: TMI-2 accident

materials behavior, plant technology and recovery, Washington, DC, USA, 30 Oct - 4 nov 1988). Order Number DE89009363/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Although the environmental consequences of the TMI accident were relatively insignificant, it was a major test of the ability of the involved state and federal radiological agencies to make a coordinated environmental monitoring response. This was accomplished largely on an ad hoc basis under the leadership of DOE. With some fine tuning, it is the basis for today's integrated FRMAP monitoring plan, which would be put into operation should another major accident occur at a US nuclear facility.

39156 (INIS-mf–11480, pp. 31-32) **Internal radiation burden of the Graz population after the Chernobyl reactor accident.** Rabitsch, H.; Feenstra, O.; Mueller, H.; Kahr, G. Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik. Nov 1988. (In German). In *Annual report of the Institute for Theoretical Physics in Graz, Austria.* Order Number DE89631627/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

CHERNOBYLSK-4 REACTOR/fallout; HUMAN POPULATIONS/radiation doses; AUSTRIA; CESIUM 134; CESIUM 137; FALLOUT; INTERNAL IRRADIATION; NATURAL RADIOACTIVITY; POTASSIUM 40; PROGRESS REPORT; TIME DEPENDENCE; REACTOR ACCIDENTS

39157 (ORNL/RASA–88/49) **Results of the radiological survey at 160 Essex Street, Lodi, New Jersey (LJ072).** Foley, R.D.; Floyd, L.M.; Carrier, R.F.; Crutcher, J.W. Oak Ridge National Lab., TN (USA). Jun 1989. 17p. Sponsored by DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89015084/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Maywood Chemical Works (MCW) of Maywood, New Jersey, generated process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores from 1916 to 1956. MCW supplied rare earth metals and thorium compounds to the Atomic Energy Commission and various other government agencies from the late 1940s to the mid-1950s. Area residents used the sandlike waste from this thorium extraction process mixed with tea and cocoa leaves as mulch in their yards. Some of these contaminated wastes were also eroded from the site into Lodi Brook. At the request of the US Department of Energy (DOE), a group from Oak Ridge National Laboratory conducts investigative radiological surveys of properties in the vicinity of MCW to determine whether a property is contaminated with radioactive residues, principally ^{232}Th, derived from the MCW site. The survey typically includes direct measurement of gamma radiation levels and soil sampling for radionuclide analyses. The survey of this site, 160 Essex Street, Lodi, New Jersey (LJ072), was conducted during 1987. Results of the survey demonstrated radionuclide concentrations in excess of the DOE Formerly Utilized Sites Remedial Action Program criteria. The radionuclide distributions are typical of the type of material originating from the MCW site. 4 refs., 10 figs., 2 tabs.

39158 (ORNL/RASA–88/50) **Results of the radiological survey at 174 Essex Street, Lodi, New Jersey (LJ073).** Foley, R.D.; Floyd, L.M.; Carrier, R.F.; Crutcher, J.W. Oak Ridge National Lab., TN (USA). Jun 1989. 11p. Sponsored by DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89015082/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Maywood Chemical Works (MCW) of Maywood, New Jersey, generated process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores from 1916 to 1956. MCW supplied rare earth metals and thorium compounds to the Atomic Energy Commission and various other government agencies from the late 1940s to the mid-1950s. Area residents used the sandlike waste from this thorium extraction process mixed with tea and cocoa leaves as mulch in their yards. Some of these contaminated wastes were also eroded from the site into Lodi Brook. At the request of the US Department of Energy (DOE), a group from Oak Ridge National Laboratory conducts investigative radiological surveys of properties in the vicinity of MCW to determine whether a property is contaminated with radioactive residues, principally ^{232}Th, derived from the MCW site. The survey typically includes direct measurement of gamma radiation levels and soil sampling for radionuclide analyses. The survey of this site, 174 Essex Street, Lodi, New Jersey (LJ073), was conducted during 1987. Results of the survey demonstrated radionuclide concentrations in excess of the DOE Formerly Utilized Sites Remedial Action Program criteria. The radionuclide distributions are typical of the type of material originating from the MCW site.

39159 (ORNL/RASA–88/69) **Results of the radiological survey at 113 Avenue E, Lodi, New Jersey (LJ081).** Foley, R.D.; Floyd, L.M. Oak Ridge National Lab., TN (USA). Jun 1989. 15p. Sponsored by DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89015083/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Maywood Chemical Works (MCW) of Maywood, New Jersey, generated process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores from 1916 to 1956. MCW supplied rare earth metals and thorium compounds to the Atomic Energy Commission and various other government agencies from the late 1940s to the mid-1950s. Area residents used the sandlike waste from this thorium extraction process mixed with tea and cocoa leaves as mulch in their yards. Some of these contaminated wastes were also eroded from the site into Lodi Brook. At the request of the US Department of Energy (DOE), a group from Oak Ridge National Laboratory conducts investigative radiological surveys of properties in the vicinity of MCW to determine whether a property is contaminated with radioactive residues, principally ^{232}Th, derived from the MCW site. The survey typically includes direct measurement of gamma radiation levels and soil sampling for radionuclide analyses. The survey of this site, 113 Avenue E, Lodi, New Jersey (LJ081), was conducted during 1988. Results of the survey demonstrated radionuclide concentrations in excess of the DOE Formerly Utilized Sites Remedial Action Program criteria. The radionuclide distributions are typical of the type of material originating from the MCW site. 5 refs, 2 figs., 3 tabs.

39160 (ORNL/RASA–88/79) **Results of the radiological survey at 79 Avenue B, Lodi, New Jersey (LJ091).** Foley, R.D.; Floyd, L.M. Oak Ridge National Lab., TN (USA). Jun 1989. 15p. Sponsored by DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89015071/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Maywood Chemical Works (MCW) of Maywood, New Jersey, generated process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores from 1916 to 1956. MCW supplied rare earth metals and thorium compounds to the Atomic Energy Commission and various other government agencies from the late 1940s to the mid-1950s. Area residents used the sandlike waste from this thorium extraction process mixed with tea and cocoa leaves as mulch in their yards. Some of these contaminated wastes were also eroded from the site into Lodi Brook. At the request of the US Department of Energy (DOE), a group from Oak Ridge National Laboratory conducts investigative radiological surveys of properties in the vicinity of MCW to determine whether a property is contaminated with radioactive residues, principally ^{232}Th, derived from the MCW site. The survey typically includes direct measurement of gamma radiation levels and soil sampling for radionuclide analyses. The survey of this site, 79 Avenue B, Lodi, New Jersey (LJ091), was conducted during 1988. Results of the survey demonstrated radionuclide concentrations in excess of the DOE Formerly Utilized Sites Remedial Action Program criteria. The radionuclide distributions are typical of the type of material originating from the MCW site. 5 refs., 2 figs., 2 tabs.

5105 Site Resource and Use Studies

Refer also to citation(s) 39173

39161 (PNL–6823) **Interim site characterization report and ground-water monitoring program for the Hanford site solid waste landfill.** Fruland, R.M.; Hagan, R.A.; Cline, C.S.; Bates, D.J.; Evans, J.C.; Aaberg, R.L. Pacific Northwest Lab., Richland, WA (USA). Jul 1989. 263p. Sponsored by DOE Nuclear Energy. DOE Contract AC06-76RL01830. Order Number DE89014963/JAW. Available from NTIS, PC A12/MF A01 - OSTI; GPO Dep.

Federal and state regulations governing the operation of landfills require utilization of ground-water monitoring systems to determine whether or not landfill operations impact ground water at the point

of compliance (ground water beneath the perimeter of the facility). A detection-level ground-water monitoring system was designed, installed, and initiated at the Hanford Site Solid Waste Landfill (SWL). Chlorinated hydrocarbons were detected at the beginning of the ground-water monitoring program and continue to be detected more than 1 year later. The most probable source of the chlorinated hydrocarbons is washwater discharged to the SWL between 1985 and 1987. This is an interim report and includes data from the characterization work that was performed during well installation in 1987, such as field observations, sediment studies, and geophysical logging results, and data from analyses of ground-water samples collected in 1987 and 1988, such as field parameter measurements and chemical analyses. 38 refs., 27 figs., 8 tabs.

5106 Regulations

Refer also to citation(s) 39151

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

39162 (DP-MS-88-252) **Macrophyte mapping in ten lakes of South Carolina with multispectral SPOT HRV data.** Mackey, H.E. Jr. Westinghouse Savannah River Co., Aiken, SC (USA). 1989. 13p. Sponsored by DOE Defense Programs. DOE Contract AC09-76SR00001. (CONF-8906171--1-Vugraphs: Special session of the summer American Society of Limnology and Oceanography, Fairbanks, AK, USA, 18-22 Jun 1989). Order Number DE89014138/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Fall and spring multispectral SPOT HRV data for 1987 and 1988 were used to evaluate the macrophyte distributions in ten freshwater reservoirs of South Carolina. The types of macrophyte and wetland communities present along the shoreline of the lakes varied depending on the age, water level fluctuations, water quality, and basin morphology. Seasonal satellite data were important for evaluation of the extent of persistent versus non-persistent macrophyte communities in the lakes. This paper contains only the view graphs of this process.

39163 (NEI-NO-82, pp. 269-279) **Episodic variation in streamwater chemistry at Birkenes, southernmost Norway: evidence for the importance of water flow paths.** Sullivan, T.J.; Christophersen, N; Hooper, R.P; Seip, H.M.; Muniz, J.P.; Sullivan, P.D.; Vogt, R.D. Norsk Hydrologisk Komite, Oslo (Norway). 1987. (CONF-870577--: International symposium on acidification and water pathways, Bolkesjo, Norway, 4-8 May 1987). In *Acidification and water pathways. Vol. 1. Proceedings of International symposium on acidification and water pathways, Bolkesjoe, 4-5 May 1987.* Order Number DE89766881/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

Changes in stream and soil water chemistry and water table variations in the Birkenes catchment during autumn rainfall and spring snow melt episodes are investigated. Labile monomeric aluminium (Al-i) concentrations in streamwater exhibited variable response to episodic increases in discharge. During events preceded by extended periods of low flow, episodic discharge coincided with large increases in (Al-i). Wet conditions were characterised by high but generally decreasing (Al-i) sometimes with drops in concentration close to discharge peaks. Streamwater was saturated with respect to synthetic gibbsite at base flow, but consistently undersaturated during wet periods. Water table measurements in pizometers situated in a subcatchment at Birkenes suggested generally higher interception of soil layers as the autumn rain season progressed. In some piezometers, later storms (when streamwater (Al-i) decreased) resulted in interception of organic horizons wich were not intercepted during earlier storms (when (Al-i) increased). These data support is that the hypothesis streamwater (Al-i) is controlled primarily by changes in water flow path during high discharge episodes. 4 figures, 18 references.

39164 **Design and preliminary evaluation of an underwater laser-based imaging system.** McRae, T. (Mc2, Livermore, CA (US)); Kulp, T.; Garvis, D.; Kennedy, R.; Salmon, T. v.v of Ocean optics IX. Blizard, M.A. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-880410--: Ocean optics 9, Orlando, FL, USA, 4-6 Apr 1988).

The design and preliminary evaluation of an underwater laser-based imaging system (UWLIS) being developed by the Lawrence Livermore National Laboratory for the Naval Sea Systems Command is described. The system is composed of a synchronously scanning argon-ion laser beam and a very narrow (4 milliradian) field-of-view detector. The laser beam and detector field of view are separated at the imaging system, but converge at the target to reduce the common optical scattering volume. The system produces a standard real-time TV image and has a predicted range of 100 m for 5 watts of laser power. The results of evaluations conducted in a 15-m deep tank at the Naval Coastal Systems Center are presented and discussed. The performance of the UWLIS in various turbid water conditions is compared to typical low-light-level underwater TV systems.

5202 Chemicals Monitoring and Transport

Refer also to citation(s) 38121, 38124, 38125, 38129, 38130, 38132, 39114, 39148, 39150, 39151, 39170, 39171, 39173

39165 (CONF-8905182--1) **Group report 4: What are the temporal and spatial variations of organic acids at the ecosystem level?.** Mulholland, P.J.; Dahm, C.N.; David, M.B.; DiToro, D.M.; Fisher, T.R.; Hemond, H.F.; Kogel-Knabner, I.; Meybeck, M.H.; Meyer, J.L.; Sedell, J.R. Oak Ridge National Lab., TN (USA). 1989. 24p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From Organic acids in aquatic ecosystems; Berlin, Germany, F.R.; 7-12 May 1989. Order Number DE89014880/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The spatial and temporal variation in organic acids and dissolved organic carbon (DOC) in freshwater ecosystems and those mechanisms which effectively regulate this variability were the primary topics for discussion. The approach was to document what is known as a result of field observations and identify what we believe to be the most important unknowns. The context of these discussions was variability in DOC concentration and quality. Fluxes per se, although extremely important to ecosystem function, were not the central issue. We recognize that DOC is a bulk parameter for organic molecules, similar to conductivity for inorganic solutes. It yields information primarily on the most abundant organic compounds, and these are often the compounds of low biological flux within aquatic ecosystems. In this discussion, the term DOC is used as a surrogate for organic acids. It is recognized that not all DOC molecules are acidic. However, a case for using DOC as an approximate measure of the influence of organic acids can be made on several grounds. 34 refs., 3 figs.

39166 (GKSS-88/E/65) **Apparatus for the investigation of microbial reaction rates in sediment suspensions.** Schroeder, F.; Bloecker, G.; Knauth, H.D. GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). 1988. 6p.

An apparatus is described for the determination of microbe-induced reaction rates in stirred sediment/water suspensions and material fluxes across the sediment/water interface of undisturbed sediment cores. The system consists of a closed gas loop coupled to a reaction vessel, thus maintaining an equilibrium between water and gasphase. The vessel is equipped with sensors for oxygen, pH and redox potential and with facilities for sampling. On-line gas analysis is done by gas chromatography with a sensitive helium-ionization detector. The oxygen concentration in the system is regulated by computer-controlled injection of oxygen into the gas loop. As an example, flux measurements of an undisturbed sediment core are presented and discussed. (orig.).

5203 Radioactive Materials Monitoring and Transport

Refer also to citation(s) 38121, 38122, 38123, 38124, 38125, 38128, 38129, 38130, 38131, 38132, 38133, 38158, 38191, 38192, 38207, 38212, 38214, 39132, 39136, 39293, 39765

39167 (BALUF-RC–87-02) **Tritium in Austrian surface waters in 1986.** Schoenhofer, F.; Weisz, J. Bundesanstalt fuer Lebensmitteluntersuchung und -forschung, Vienna (Austria). 1987. 40p. (In German). Order Number DE89631115/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The concentration of tritium in surface water from sampling stations at the rivers and lakes Danube, March, Thaya, Mur, Drau, Ill, Inn, Leitha, Rhine, Bodensee, Salzach, Neusiedler See, Fuschlsee are given. The measurements were done by liquid scintillation counting without enrichment with an ultra-low-level-counter. As expected no rise due to the accident in Chernobyl could be found. Only in the Thaya-river slightly elevated levels were found in autumn which might originate from the nuclear power plant at Dukovany in the CSSR. 3 refs., 22 figs., 11 tabs.

39168 (BALUF-STS-KLAER–88) **Valuating report on radionuclide concentrations in the waste water and mixed slurry from the Vienna main clarifying plant for 1988.** Henrich, E.; Weisz, J.; Zapletal, M.; Haider, W. Bundesanstalt fuer Lebensmitteluntersuchung und -forschung, Vienna (Austria). Mar 1989. 25p. (In German). Order Number DE89631116/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Sample preparation- and measuring methods, and results on 16 nuclides from the Vienna clarifying plant for 1988 are presented. Comparisons with the 1987 values are made and hypotheses about the sources of radionuclides - natural, atmospheric atomic weapons tests, Chernobyl accident and medical applications - are presented. An estimation of the activity transferred to the surface waters (Danube) over 1988 is also made. 16 refs., 8 figs., 6 tabs. (qui).

39169 (BALUF-STS-OWAS–88) **Valuating report on radioactivity concentrations in surface waters in 1988.** Henrich, E.; Weisz, J.; Zapletal, M.; Friedrich, M.; Haider, W. Bundesanstalt fuer Lebensmitteluntersuchung und -forschung, Vienna (Austria). Feb 1989. 48p. (In German). Order Number DE89631117/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Sample preparation- and measuring methods and results on river and lake water samples for 1988 are presented. This is part of the Austrian Environment Radioactivity Monitoring Network. 22 sampling sites and 9 nuclides - natural, atomic weapons tests and Chernobyl fallout - were assessed. Emphasis was on the Chernobyl fallout; iodine 131, chromium 51 and cobalt 60. Hypotheses on the origin of the radionuclides are presented. The radiation burden to the population is marginal. 15 refs., 19 figs., 15 tabs. (qui).

39170 Application of stochastic methods for the simulation of solute transport in discrete and continuum models of fractured rock systems. Smith, L. (Univ. of British Columbia, Vancouver (Canada)); Schwartz, F.; Mase, C. pp. 658 of Geostatistical, sensitivity, and uncertainty methods for ground-water flow and radionuclide transport modeling. Proceedings. Buxton, B.E. (ed.) Battelle Memorial Institute, Columbus, OH (1989). From Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference; San Francisco, CA, USA; 15-17 Sep 1987.

This paper addresses two issues currently limiting the application of solute transport models in fractured rock systems. Existing continuum models, developed originally for porous media, invariably assume dispersion is an isotropic process, although dispersion is known to be an anisotropic process in fractured rock. A continuum approach is described that can account for anisotropic dispersion in a network of finite-length fractures. The technique is based on particle-tracking methods. Statistics describing particle transport are collected from a discrete fracture model. This discrete model is a small-scale prototype of the much larger system of interest. These statistics are used to control the pattern of transport in the larger continuum and enable us to mimic in the larger system the particle transport that is observed in the smaller system. The second issue addressed concerns the magnitude of potential errors in the interpretation of hydraulic and tracer tests to estimate fracture aperture. Discrete network models require data on fracture aperture to transform a geometric model of the network into a hydraulic model. Numerical experiments are described that suggest that large differences in aperture estimates based on hydraulic and tracer tests are possible because of differing sensitivity to the effects of network geometry and spatial variability in aperture. Difficulties arise from the application of an axisymmetric flow model to characterize the velocity field within the fracture isolated for testing.

39171 Equivalent permeability of statistically simulated single fractures. Coakley, K. (Lawrence Berkeley Lab., CA (USA)); Muralidhar, K.; Long, J.C.S.; Myer, L.R. pp. 658 of Geostatistical, sensitivity, and uncertainty methods for ground-water flow and radionuclide transport modeling. Proceedings. Buxton, B.E. (ed.) Battelle Memorial Institute, Columbus, OH (1989). From Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference; San Francisco, CA, USA; 15-17 Sep 1987.

We have developed a statistical model for simulating void spaces and contact areas in a single fracture. We have identified the two-point correlation function as a connectivity statistic for the void spaces. Given an observed pattern of fracture void spaces and contact areas in the plane of the fracture, we simulate other statistically similar void space geometries, which have the same two-point correlation function as the observed void space geometry. We use finite-difference procedures to compute equivalent permeabilities of the real and simulated fractures. We solve law and then by solving the three-dimensional Navier-Stokes equations for laminar flow. When assuming Darcy's law, we equate local hydraulic conductivity to aperture squared. While solving the Navier-Stokes equations, we use a coordinate transformation technique. In our present work, we assign small aperture values to contact areas in order to circumvent computer time problems. Both flow models account for complex boundary shapes. We show that the equivalent permeabilities computed with the Navier-Stokes model are always less than the equivalent permeabilities computed with the Darcy's law model. Using the Darcy model, we study the variability of permeability and scale effects. We compare the equivalent permeability of simulated fractures to an observed fracture. We also present a lower bound for the variability of equivalent permeability, using Darcy's law. We then extend the bound to the case where voids have variable aperture distributions.

39172 (IG–89/01) **Tritium content of precipitation and surface water in Austria in 1988.** Rank, D.; Rajner, V.; Lust, G. Bundesversuchs- und Forschungsanstalt Arsenal, Vienna (Austria). 1989. 35p. (In German). Order Number DE89631118/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This report includes weighted monthly ^{3}H-means from 23 precipitation sampling stations, ^{3}H-concentrations of daily precipitation samples from the station Wien-Arsenal, and ^{3}H-concentrations of monthly samples from 17 surface water sampling stations. 18 figs., 3 tabs.

39173 (PNL–6844-Vol.1) **RCRA [Resource Conservation and Recovery Act of 1976] ground-water monitoring projects for Hanford facilities: Progress report, October 1–December 31, 1988: Volume 1, Text.** Fruland, R.M.; Bates, D.J.; Lundgren, R.E. Pacific Northwest Lab., Richland, WA (USA). Apr 1989. 276p. Sponsored by DOE Nuclear Energy. DOE Contract AC06-76RL01830. Order Number DE89010636/JAW. Available from NTIS, PC E14/MF E06 - OSTI; GPO Dep.

Includes 23 sheets of 48x reduction microfiche.

This report describes the progress of 13 Hanford ground-water monitoring projects for the period October 1 to December 31, 1988. There are 16 individual hazardous waste facilities covered by the 13 ground-water monitoring projects. The Grout Treatment Facility is included in this series of quarterly reports for the first time. The 13 projects discussed in this report were designed according to applicable interim-status ground-water monitoring requirements specified in the Resource Conservation and Recovery Act of 1976 (RCRA). During this quarter, field activities primarily consisted of sampling and analyses, and water-level monitoring. The 200 Areas Low-Level Burial Grounds section includes sediment analyses in addition to

ground-water monitoring results. Twelve new wells were installed during the previous quarter: two at the 216-A-29 Ditch, six at the 216-A-10 Crib, and four at the 216-B-3 Pond. Preliminary characterization data for these new wells include drillers' logs and other drilling and site characterization data, and are provided in Volume 2 or on microfiche in the back of Volume 1. 26 refs., 28 figs., 74 tabs.

5205 Site Resource and Use Studies

39174 (WCWWA–8710) **Proceedings of the 39th annual convention of the Western Canada Water and Wastewater Association.** Western Canada Water and Wastewater Association, Calgary, AB (Canada). 1987. 317p. (CONF-8710478–: 39. annual convention of the Western Canada Water and Wastewater Association, Saskatoon, Canada, 21-23 Oct 1987;CE–02659). Available from Western Canada Water and Wastewater Association, P.O. Box 6168, Postal Station A, Calgary, AB, Canada T2H 2L4; $20.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report deals with methods, systems, and equipment for the abatement and treatment of water pollution. Separate abstracts were prepared for two papers.

5206 Regulations

Refer also to citation(s) 38212, 38222, 38253

39175 Water quality criteria for hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX). Etnier, E.L. (Oak Ridge National Lab., TN (USA)). *Regulatory Toxicology and Pharmacology (USA),* 9(2): 147-157 (Apr 1989).

The occurrence of the munitions compound hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) in groundwater surrounding Army ammunition plants may result in contamination of local drinking water supplies. RDX exerts its primary toxic effect in humans on the central nervous system, but also involves gastrointestinal and renal effects. Symptomatic effects following acute exposure include hyperirritability, nausea, vomiting, generalized epileptiform seizures, and prolonged postictal confusion and amnesia. Health effects data were analyzed for RDX, and although no controlled human studies exist concerning the acute or chronic toxic effects of exposure to RDX, sufficient animal toxicity data are available to derive an ambient water quality criterion for the protection of human health. This paper summarizes the available literature on metabolism of RDX and human and animal toxicity. Based on noncarcinogenic mammalian toxicity data, and following the methodologies of the U.S. Environmental Protection Agency, an ambient water quality criterion for the protection of human health of 103 micrograms/liter is proposed for ingestion of drinking water and aquatic foodstuffs. A criterion of 105 micrograms/liter is proposed for ingestion of drinking water alone.54 references.

53 ENVIRONMENTAL–SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5302 Assessment of Energy Technologies

Refer also to citation(s) 38139, 38140, 38141, 38142, 38143

55 BIOMEDICAL SCIENCES, BASIC STUDIES

Refer also to citation(s) 39652

39176 Fossil evidence on human origins and dispersal. Andrews, P. (British Museum (Natural History), London (England)). pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

With increasingly sophisticated biochemical methods, the sequence and timing of evolutionary events are becoming more precisely documented. With a similar increase in the methods of analysis and availability of fossils for study, the timing and place of evolutionary events can be inferred with an increasing degree of confidence. Both approaches support Darwin's suggestion that humans originated in Africa, and a series of events can now be recognized in the fossil record suggesting successive African origins for several hominoid lineages followed by dispersals into Europe and Asia. The order and dates for these branching events are described here. The Hominoidea are clearly an African group, being restricted to this continent for the first 8-10 Myr of their known history. They reached their highest levels of species diversity during the first half of the Miocene period, and the subsequent decline in diversity has produced the restricted populations of great apes living today. The time and place of gibbon divergence from the great apes was earlier than 17 Myr in Africa, and the evidence for the divergence of the orangutan from the African apes and humans suggests a date of earlier than 13 Myr. The order and time of branching within the African ape and human clade is not yet clear, but fossil evidence for the clade places it in Africa 7-9 Myr ago. The human fossil record is restricted to Africa from 1-5 Myr, but since this time, successive radiations gave rise firstly to Homo erectus in Asia at about 1 Myr from an African radiation dating back to more than 1.6 Myr. 63 references, 5 figures.

5502 Biochemistry

Refer also to citation(s) 38269, 38270, 38272, 38294, 38295, 39176, 39221, 39228, 39230, 39238, 39239, 39251, 39252, 39253, 39254, 39255, 39259, 39261, 39267, 39342

39177 Seven unidentified reading frames of human mitochondrial DNA encode subunits of the respiratory chain NADH dehydrogenase. Attardi, G. (California Institute of Technology, Pasadena (USA)); Chomyn, A.; Doolittle, R.F.; Mariottini, P.; Ragan, C.I. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

One of the most intriguing findings from the sequence analysis of human mtDNA was the discovery that more than half of its protein-coding capacity resides in eight reading frames, which, with one exception, have no obvious amino acid sequence homology to any of the identified or unidentified reading frames (URF) of Saccharomyces cerevisiae and Schizosaccharomyces pombe, although several of them were later found to occur in mtDNA of other lower eukaryotic cells. These reading frames were suspected very early to be functional genes, because of the evidence of their transcription into RNAs with the same structural and metabolic properties as the mRNAs of identified genes, and because of their strong conservation in size and amino acid sequence in different mammalian species. The discovery of the mammalian mtDNA URFs, besides providing striking evidence of the individuality of the mitochondrial genomes of different organisms, created a challenge for investigators in the field. This report is an account of the identification of the polypeptides encoded in all the human mtDNA URFs and to their functional assignment, and thus to the complete elucidation of the informational content of this genome. 52 references, 7 figures, 2 tables.

39178 Molecular approaches to the characterization of megabase regions of DNA: applications to the human major histocompatibility complex. Lawrance, S.R. (Yale Univ. School of Medicine, New Haven, CT (USA)); Srivastave, R.; Rigas, B.; Chorney, M.J.; Gillespie, G.A.; Smith, C.L.; Cantor, C.R.; Collins, F.S.; Weissman, S.M. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

We have applied cosmid cloning, PFGE, and chromosome jumping techniques to the analysis of the molecular organization of the human major histocompatibility complex (MHC). Together, these

techniques enable extended genetic regions, such as the MHC, to be studied at any level of resolution between the single nucleotide and several million base pairs. We have also described several additional techniques that have potential usefulness in mapping and cloning very large regions of DNA for which little or no genetic or molecular data are available. Various combinations of jumping, linking, and cosmid libraries and the RecA-mediated enrichment procedures have considerable potential for the efficient analyses of the organization of DNA segments, in principle as large as entire human chromosomes. The refinement of these techniques should expedite the full-scale structural analysis of mammalian genomes, provide new insights into the processes of molecular evolution, and aid in the delineation of the structural variations associated with genetic disorder. 30 references, 4 figures.

39179 Cloning the gene for the inherited disorder chronic granulomatous disease on the basis of its chromosomal location. Royer-Pokora, B. (Harvard Medical School, Boston, MA (USA)); Kunkel, L.M.; Monaco, A.P.; Goff, S.C.; Newburger, P.E.; Baehner, R.L.; Cole, F.S.; Curnutte, J.T.; Orkin, S.H. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

Individuals afflicted with chronic granulomatous disease (CGD) have impaired host defenses against infection with common microorganisms. Upon ingestion of bacteria or particles, phagocytes of CGD patients fail to generate superoxide and other activated oxygen species. The lesion in the membrane-associated NADPH-oxidase of these cells is unknown despite considerable biochemical investigation. X-chromosome-linked and recessive varieties of the disorder have been identified. In the majority of families, the disease is X-linked. Limited linkage analyses previously suggested linkage of the disease to Xg, the most distal Xp marker. Biochemical studies have demonstrated a deficiency of the spectrum of an unusual b-type cytochrome in the vast majority of X-linked patients. In view of inherent problems in conventional biochemical analysis of the disorder, we have undertaken a genetic approach. Our goals have been to locate the CGD gene on the X chromosome, identify the gene, and characterize its predicted product as a means of delineating at least one critical component of the oxidase system. From the findings summarized below, we believe that CGD is the first disease for which molecular cloning has provided a specific gene without reference to protein data. 26 references, 6 figures.

39180 Specific enzymatic amplification of DNA in vitro: the polymerase chain reaction. Mullis, K. (Cetus Corporation, Emeryville, CA (USA)); Faloona, F.; Scharf, S.; Saiki, R.; Horn, G.; Erlich, H. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

We have been exploring a method for the synthesis of specific DNA sequences which involves the reciprocal interaction of two oligonucleotides and the DNA polymerase extension products, whose synthesis they prime, when they are hybridized to different strands of a DNA template where their extension products overlap. The method consists of repetitive cycles of denaturation, hybridization, and polymerase extension and seems not a little boring until the realization occurs that this procedure is catalyzing a doubling with each cycle in the amount of the fragment defined by the position of the 5' ends of the two primers on the template DNA, that this fragment is therefore increasing in concentration exponentially, and that the process can be continued for many cycles and is inherently very specific. The original template DNA molecule could be a relatively small amount of the sequence to be synthesized (in a pure form and as a discrete molecule) or it could be the same sequence embedded in a much larger molecule in a complex mixture as in the case of a fragment of a single-copy gene in whole human DNA. It could be a single-stranded DNA molecule or, with a minor modification in the technique, it could be a RNA molecule. In any case, the product of the reaction will be a discrete double-stranded DNA molecule with termini corresponding to the 5' ends of the oligonucleotides employed. We have called this process polymerase chain reaction. Several embodiments have been devised that enable one not only to extract a specific sequence from a complex template and amplify it, but also to increase the inherent specificity of this process by using nested primer sets, or to append sequence information to one or both ends of the sequence as it is being amplified, or to construct a sequence entirely from synthetic fragments. 12 references, 7 figures, 2 tables.

39181 Searching for gene defects by denaturing gradient gel electrophoresis. Lerman, L.S. (Genetics Institute, Cambridge, MA (USA)); Silverstein, K.; Grinfeld, E. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

This report is concerned with estimating the likelihood that a random base change in an unknown sequence can be detected by denaturing gradient gel electrophoresis. The estimate is based on theoretical calculations that simulate experimental results in detail and agree closely with experiments where they have been tested. We have taken a large contiguous portion (about 35.4 kb) of the human β-globin gene cluster as a sample of the genome; break it into fragments by each of two 4-base-specific restriction endonucleases; hybridize the digest with similarily fragmented, guaranteed wild-type DNA; and apply the resulting mixture to a denaturing gradient gel. The effect of a possible mismatch due to a base substitution, an insertion, or a deletion at every tenth base was systematically determined. The total fraction of the full 35.4 kb in which changes might be discerned will be compiled from a relatively conservative criterion for a distinct signal. 24 references, 6 figures.

39182 Molecular genetics of Down's syndrome: overexpression of transfected human Cu/Zn-superoxide dismutase gene and the consequent physiological changes. Groner, Y. (Weizmann Institute of Science, Rehovot (Israel)); Elroy-Stein, O.; Bernstein, Y.; Dafni, N.; Levanon, D.; Danciger, E.; Neer, A. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

To investigate a possible involvement of CuZnSOD overproduction in the etiology of DS, we first cloned its cDNA, isolated the gene, and studied its molecular structure and expression in normal individuals versus DS patients. We then introduced both the gene and the cDNA into mouse and human cells, obtained transformants overproducing CuZnSOD, and examined them for consequent physiological changes. 80 references, 8 figures, 2 tables.

39183 Relationships of human protein sequences to those of other organisms. Doolittle, R.F. (Univ. of California, San Diego, La Jolla (USA)); Feng, D.F.; Johnson, M.S.; McClure, M.A. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

Presently more than 4000 amino acid sequences are known, including more than 200 representing human proteins. Many of the sequences, which are being reported at an ever-increasing rate, have been inferred from nucleic acid sequences, and often the protein itself is not necessarily in hand. In such cases there is much that can be learned by comparison with sequences from other species or with other related proteins. Furthermore, the entire course of human history lies in our genes and can be read through the sequences of our proteins. In this article an attempt is made to chart some of the major divergences that have led to human proteins over the past few billion years. In this regard we have categorized the sequenced proteins into several arbitrary groups, beginning with the most ancient and continuing through to the modern. 28 references, 6 figures, 6 tables.

39184 LINE-1 family of primates may encode a reverse transcriptase-like protein. Sakaki, Y. (Kyushu Univ., Fukuoka (Japan)); Hattori, M.; Fujita, A.; Yoshioka, K.; Kuhara, S.; Takenaka, O. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

Several L1 family members were isolated from genomic DNA libraries of the slow loris (N. coucang) and human, and their nucleotide sequences were determined. A large open reading frame (ORF) of 927 amino acid residues was found in L1Nc4; all the large ORFs in other members were found to use the same reading frame as the large ORF of LINc4, and they overlapped each other. Consensus nucleotide sequences for the prosimian and human L1 families were deduced and were found to be capable of encoding a very large ORF of more than 1200 amino acid residues. Human and prosimian large ORFs showed a homology of about 65% of each other, but the non-ORF regions showed very low homologies. Evolutionarily conserved functions and signals were identified in the L1 family, making it more likely that the L1 family is a kind of retrotransposon. 23 references, 3 figures.

39185 Structural features of the proteins participating in blood coagulation and fibrinolysis. Davie, E.W. (Univ. of Washington, Seattle (USA)); Ichinose, A.; Leytus, S.P. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

A number of different domains or structures of the serine proteases have been identified. These domains play a specific roles in the binding or interaction of the serine proteases with their cofactors, phospholipid membranes, surfaces, or small molecules. These structures include the kringle domains present in prothrombin, factor XII, plasminogen, tissue plasminogen activator, and urokinase; the γ-carboxyglutamic acid domains present in the vitamin-K-dependent proteins, including prothrombin, factor VII, factor IX, factor X, and protein C; the epidermal growth-factor domains that are homologous to structures present in factor VII, factor IX, factor X, factor XII, protein C, tissue plasminogen activator, and urokinase; the type I and type II domains of fibronectin that are homologous to structures in factor XII and tissue plasminogen activator; and the tandem repeats that have been found in factor XI and plasma kallikrein. Since all of these proteins are secreted into plasma, they are also synthesized with a hydrophobic leader sequence. The evolution of these proteins apparently occurred through a series of translocation events during the last 500 million years. This would involve the transfer of segments of DNA coding for the various domains from one gene to another. Eventually, new serine proteases are generated with different biological functions. In some cases, the introns in these genes may be involved in the shuffling process, since the genes for these proteins often have similar organization and structure. 48 references, 4 figures, 1 table.

39186 Structure and evolution of the human genes encoding protein C and coagulation factors VII, IX, and X. Long, G.L. (Lilly Research Laboratories, Indianapolis, IN (USA)). pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

A comparison of the intron positions for human protein-C, factor X, and factor IX genes shows that they are identical, suggesting that the genes have a close evolutionary relationship. However, a comparison of intron size and gene base composition for protein-C and factor IX genes shows that they are significantly divergent. This disparity for factor IX also exists in coding regions when compared with protein C and factors VII and X. No clear explanation for the compositional divergence of the factor IX genes exists. One possibility is a cytosine to thymine transition via methylation and subsequent deamination. 25 references, 3 figures, 2 tables.

39187 Isolation and expression of cDNAs encoding human factor VII. Berkner, K. (ZymoGenetics, Inc., Seattle, WA (USA)); Busby, S.; Davie, E.; Hart, C.; Insley, M.; Kisiel, W.; Kumar, A.; Murray, M.; O'Hara, P.; Woodbury, R. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

The authors report here the isolation of human factor VII cDNAs from cDNA libraries prepared from HepG2 cells and human liver polyA+ RNA. The identity of these cDNAs has been confirmed by comparison to factor VII amino acid sequence data, and to DNA sequence data derived from factor VII-containing genomic clones. The cDNAs encode a mature factor VII protein of 406 amino acids, which includes a gla domain, two potential EGF domains, and a serine protease domain. DNAs encoding differing leader lengths (38 or 60 amino acids) have been identified in the cDNA population. Factor VII exhibits a high degree of homology with the other vitamin K-dependent plasma proteins. Full-length factor VII cDNAs with the two different leaders have each been inserted into a mammalian expression vector. These plasmids have been transfected into mammalian cells. Secretion of recombinant factor VII has been observed in cos cells, BHK cells and HepG2 cells in transient analysis, and stably transfected cell lines secreting factor VII have been established. The levels of factor VII expression from the two cDNAs with different leader sequences are approximately the same. The biological activity of the recombinant factor VII has been demonstrated in a one step clotting assay: in preliminary studies, the percentage of biologically active protein is at least 60%. 55 references, 6 figures, 2 tables.

39188 Exploration of structure-function relationships in human factor VIII by site-directed mutagenesis. Toole, J.J. (Genetics Institute, Inc., Cambridge, MA (USA)); Pittman, D.; Murtha, P.; Wasley, L.C.; Wang, J.; Amphilett, G.; Hewick, R.; Foster, W.B.; Kamen, R.; Kaufman, R.J. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

We describe in vitro mutagenesis of factor VIII, which demonstrates that most of the B domain is dispensable for in vitro procoagulant activity. In addition, we describe the effects of thrombin cleavage-site mutants, produced in vitro, on factor VIII activity. 26 references, 4 figures, 2 tables.

39189 Biochemical and biological properties of single-chain urokinase-type plasminogen activator. Stump, D.C. (Univ. of Leuven (Belgium)); Lijnen, H.R.; Collen, D. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

Initial studies with pro-urokinase showed potential for a considerable degree of fibrin-specific clot lysis. Identification of enriched sources and development of straightforward methods for the purification of human single-chain u-PA (scu-PA) and cloning in Escherichia coli, have now made highly purified scu-PA more readily available for study. These materials have been utilized to characterize further the unique biochemical and biological properties of scu-PA as presented in this paper.

39190 Interleukin-2 and its receptor: structure and functional expression of the genes. Taniguchi, T. (Osaka Univ. (Japan)); Fujita, T.; Hatakeyama, M.; Mori, H.; Matsui, H.; Sato, T.; Hamuro, J.; Minamoto, S.; Yamada, G.; Shibuya, H. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

Elucidation of the structure and control mechanism of IL-2 and its receptor genes would give insight into the regulatory function of the

IL-2 system in lymphocyte growth and differentiation. Furthermore, the use of a cloned gene for the human IL-2 should make it possible to provide essentially unlimited amounts of recombinant IL-2. In this paper, we describe our studies on the structure and expression of IL-2 and its receptor genes. 55 references, 7 figures, 1 table.

39191 Lymphokines and monokines in anti-cancer therapy. Fiers, W. (State Univ. of Ghent (Belgium)); Brouckaert, P.; Devos, R.; Fransen, L.; Leroux-Roels, G.; Remaut, E.; Suffys, P.; Tavernier, J.; Van der Heyden, J.; Van Roy, F. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

Only 5 years after its discovery, interferon was shown to have antiproliferative effect on transformed cells. Nevertheless, it took an awfully long time before the clinical potential of interferon was extensively tested, and the reasons for this slow progress were more complex than simple availability. But the emerging genetic engineering methodology brought the promise to produce human interferon cheaply in unlimited amounts. So we and others started out to clone the corresponding genes and to express them in bacteria. The first results were obtained with the type I interferons, leukocyte or IFN-α and fibroblast or IFN-β. Because of the restricted species specificity of the interferons, it is usually necessary to isolate and develop not only the human gene, but also the homologous mouse system so that extensive biological and preclinical studies can be carried out. 63 references, 4 figures, 2 tables.

39192 Tumor necrosis factors: gene structure and biological activities. Goeddel, D.V. (Genentech, Inc., San Francisco, CA (USA)); Aggarwal, B.B.; Gray, P.W.; Leung, D.W.; Nedwin, G.E.; Palladino, M.A.; Patton, J.S.; Pennica, D.; Shepard, H.M.; Sugarman, B.J. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

Our understanding of the tumor necrosis factor (TNF) system has advanced tremendously over the past few years. The elucidation of the sequences of TNF-α and TNF-β by direct biochemical analysis and cDNA cloning has revealed that these cytokines are structurally related. Furthermore, the TNF genes are closely linked, their expression is tightly regulated, and the encoded gene products share many important biological properties. The biological activities of TNF-α and TNF-β are mediated through interaction with a common cell-surface receptor. The availability of cloned TNF genes and highly purified TNF preparations from recombinant E. coli should make it possible to address the many questions that remain unanswered concerning the regulation of TNF expression and the mechanisms of TNF action. 59 references, 8 figures, 4 tables.

39193 Tandem arrangement of genes coding for tumor necrosis factor (TNF-α) and lymphotoxin (TNF-β) in the human genome. Nedospasov, S.A. (Institute of Molecular Biology, Moscow (USSR)); Shakhov, A.N.; Turetskaya, R.L.; Mett, V.A.; Azizov, M.M.; Georgiev, G.P.; Korobko, V.G.; Dobrynin, V.N.; Filippov, S.A.; Bystrov, N.S. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

Tumor necrosis factor and lymphotoxin, also termed TNF-α and TNF-β, are polypeptides secreted by peripheral blood leukocytes. Their production is induced by mitogens, phorbol esters, or interleukin 2. TNF-α and TNF-β share 30% amino acid homology and show similar cytostatic and cytolytic activities in vitro and in vivo. TNF-α is produced by activated macrophages, whereas TNF-β (lymphotoxin) is produced by stimulated lymphocytes. In this paper, we present data on the close proximity of human TNF-α and TNF-β genes in regard to the study of molecular organization of human genome. 49 references, 7 figures, 1 table.

39194 Cachectin: the dark side of tumor necrosis factor. Cerami, A. (Rockefeller Univ., New York, NY (USA)); Beutler, B. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

Animals or humans infected with various bacteria, parasites, or viruses develop a catabolic state that, if unremitting, can advance to severe cachexia (wasting), shock, and death. Investigation into the mechanism of paradoxical hypertriglyceridemia revealed a deficiency of the enzyme lipoprotein lipase (LPL), which is essential for clearing triglyceride from the blood. In the rabbit, very low density lipoprotein (VLDL) synthesis by the liver continues unabated, leading to very high VLDL levels in the plasma in the cachectic state. A macrophage factor was found to suppress LPL activity on the surface and within cells of the adipocyte line 3T3-L1. This activity served as the basis for the subsequent isolation of the monokine, cachectin. Subsequent studies with specific cDNA clones pointed to the ability of this monokine to suppress biosynthesis of glycerol phosphate, dehydrogenase and the fatty acid binding protein present in the adipocyte. The mechanism for this switching on and off of particular genes is not known. Apparently, a repertoire of genes is altered that switches the metabolism of the cell from an anabolic state to a catabolic state. Addition of the monokine to 3T3-L1 preadipocytes also prevents the morphological differentiation to form adipocytes, whereas the addition to mature adipocytes laden with lipid prompts a loss of lipid droplets and a form of in vitro cachexia. 34 references.

39195 Molecular biology of interleukin-1. Lomedico, P.T. (Hoffmann-La Roche Inc., Nutley, NJ (USA)); Kilian, P.L.; Gubler, U.; Stern, A.S.; Chizzonite, R. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

Interleukin-1 (IL-1) was first described as lymphocyte-activating factor for its ability to costimulate mitogen-activated mouse thymocyte proliferation. It has since become clear that IL-1 has a number of other biological activities and that there are at least two major types of IL-1 proteins produced by activated macrophages and by other cell types. Some of the activities ascribed to IL-1 include the ability to stimulate B-cell function, fibroblast proliferation, muscle proteolysis, prostaglandin E2 and collagenase production by rheumatoid synovial cells, hepatic acute-phase protein synthesis, and to induce fever. Although its activities are numerous and diverse, it has been suggested that IL-1 plays an important role in stimulating immune and inflammatory responses in the body's defense against infection and other forms of trauma. IL-1 is also believed to contribute to the pathology observed in certain chronic inflammatory conditions. In the past few years, the cloning and expression of the genes coding for the IL-1 proteins have greatly expanded our knowledge of IL-1 structure and function. 48 references, 8 figures.

39196 Development of Mullerian inhibiting substance as an anti-cancer drug. Cate, R.L. (Biogen Research Corporation, Cambridge, MA (USA)); Ninfa, E.G.; Pratt, D.J.; MacLaughlin, D.T.; Donahoe, P.K. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

This investigation seeks to determine whether Mullerian inhibiting substance (MIS), a testicular glycoprotein that inhibits the growth of cells during male embryonic development, can also inhibit the growth of tumor cells. Early in the sexual development of the male embryo, both the Wolffian and Mullerian ducts begin to develop in the urogenital ridges. Under the influence of testosterone, the Wolffian duct continues to develop into the epididymas, vas deferens, and seminal vesicles. The Mullerian duct, which develops into the

uterus, vagina, and fallopian tubes in the normal female embryo, regresses due to MIS. Programmed cell death also plays an important role in this developmental process. To test the hypothesis that MIS might be an effective anti-cancer agent, it was demonstrated that testicular extracts were cytotoxic to a human ovarian serous cystadenocarcinoma cell line. Bovine MIS inhibited the growth of tumors in nude mice when incubated with HOC-21 or HEC-1 cells prior to implantation. In these experiments, MIS did not affect the tumorigenicity of a colon tumor cell line, indicating that it was acting in a specific manner. These experiments have provided a basis for developing MIS as a biologic therapy for cancer. However, extensive testing of MIS in animals has been difficult due to its scarcity. To solve this problem, we have isolated the human gene and expressed it in CHO cells. The protein is glycosylated by the CHO cells and is active in the organ culture assay. 38 references, 5 figures, 1 table.

39197 Endogeneous and heterologous expression of transforming growth factor-α in mammalian cells. Derynck, R. (Genentech, Inc., San Francisco, CA (USA)); Rosenthal, A.; Lindquist, P.B.; Bringman, T.S.; Goeddel, D.V. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

Two distinct polypeptides have been termed transforming growth factors: TGF-α is related to epidermal growth factor (EGF) and binds to the EGF receptor, and TGF-β is a structurally unrelated protein that recognizes a different receptor. TGF-α was originally isolated from murine-sarcoma-virus-transformed fibroblast cultures. Subsequent examination of a variety of cell sources showed that this factor was made by many more transformed cell lines but not by adult normal cells in culture. The fact that this factor was able to convert normal rat kidney cells into phenotypically transformed cells, and its synthesis by various transformed cells, led to the name transforming growth factor. Extensive biochemical purification and characterization showed that the preparations consisted of the structurally unrelated peptides TGF-α and TGF-β and that the profound morphological changes induced in NRK fibroblasts are due to their cooperative effect. TGF-β by itself will not induce any colony formation of NRK cells in soft agar, whereas pure TGF-α can elicit the formation of a few relatively small colonies. The need for both growth factors to promote phenotypic transformation is dependent on the cell system used. Both TGF-α and TGF-β are needed in the NRK system, whereas in many other cell systems, they do not have a cooperative effect on cell proliferation or transformation. 36 references 3 figures, 1 table.

39198 Human basic fibroblast growth factor: nucleotide sequence, genomic organization, and expression in mammalian cells. Abraham, J.A. (California Biotechnology, Inc., Mountain View (USA)); Whang, J.L.; Tumolo, A.; Mergia, A.; Fiddes, J.C. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

The involvement of endothelial cell proliferation in the process of angiogenesis implicated endothelial cell growth factors as possible candidates for the signal that initiates capillary growth. A variety of endothelial cell mitogens have indeed been shown to stimulate new capillary growth in angiogenic assays. One of the best characterized of these proteins, basic fibroblast growth factor (FGF) is a potent mitogen for endothelial cells and serves as a chemoattractant for these cells. The protein has a pI of 9.6 and binds strongly to heparin-Sepharose. Basic FGF purified from bovine pituitary was shown by protein sequence analysis to contain 146 amino acids. Basic FGF shares 55% amino acid sequence homology with a second endothelial cell mitogen, acidic FGF. Presented here is an overview of the cloning of human and bovine basic FGF. DNA sequence analysis of the clones has shown that human basic FGF is remarkably similar to the bovine protein, differing by only two amino acids. Both the human and bovine proteins appear to be synthesized initially with an amino-terminal extension of nine residues, but without an obvious signal peptide. Southern blot analysis demonstrates that basic FGF is encoded by a single gene, confirming that the closely related, basic heparin-binding endothelial cell mitogens are in fact all products of a single gene. 36 references, 2 figures.

39199 Human growth hormone: from clone to clinic. Seeburg, P.H. (Genentech, Inc., San Francisco, CA (USA)). pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

The efficacy of hGH in short children generated a high demand for this hormone by clinical endocrinologists and pediatricians. In 1963, the National Pituitary Agency was formed to collect human pituitary glands, to organize the extraction of hGH, and to distribute them for hypopituitary children. By the late 1970s, this agency was collecting 60,000 pituitaries per year to treat 1600 hypopituitary dwarfs in the United States. Because of its species specificity, hGH could only be obtained from human cadavers. Contamination of hGH was recognized as a potential source of infectious disease. The need to develop a new source of hGH coincided with the advent of recombinant DNA technology. This paper traces the molecular biology of hGH from clone to clinic. 46 references, 8 figures.

39200 Molecular and biological properties of human macrophage growth factor, CSF-1. Ralph, P. (Cetus Corporation, Emeryville, CA (USA)); Warren, M.K.; Ladner, M.B.; Kawasaki, E.S.; Boosman, A.; White, T.J. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

CSF-1 belongs to a family of colony-stimulating factors that regulate the production of the blood cells. CSF-1 is a specific growth and differentiation factor for bone-marrow progenitor cells of the mononuclear phagocyte lineage and also promotes the proliferation of mature macrophages via specific receptors on the responding cells. CSF-1 also has a variety of stimulatory effects on the function of macrophages and monocytes. In this paper, we summarize the cloning of the cDNA and the genomic structure of human CSF-1, and we describe properties of the macrophage growth factor that may make it a useful drug in several clinical settings. 23 references, 3 figures, 3 tables.

39201 Effects of N-linked carbohydrate on the in vivo properties of human GM-CSF. Donahue, R.E. (Genetics Institute, Inc., Cambridge, MA (USA)); Wang, E.A.; Kaufman, R.J.; Foutch, L.; Leary, A.C.; Witek-Giannetti, J.; Metzger, M.; Hewick, R.M.; Steinbrink, D.R.; Shaw, G. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

Granulocyte-macrophage colony-stimulating factor (GM-CSF) is a hematopoietic growth factor capable of stimulating the formation of colonies containing both granulocytes and macrophages. Both the murine and human GM-CSF have been cloned. It has thus become possible to perform studies of the physical and biological properties of these proteins. GM-CSF has proved to be a potent activator of mature neutrophils, eosinophils, and monocytes. In preparation for clinical studies, we have addressed the in vivo properties of this protein. Here, we describe the effects of glycosylation on the kinetics of clearance of GM-CSF using a rat model and present results of a study of the dose responsiveness of GM-CSF in our primate model. 29 references, 5 figures, 1 table.

39202 Erythropoietin: gene cloning, protein structure, and biological properties. Browne, J.K. (Amgen, Thousand Oaks, CA (USA)); Cohen, A.M.; Egrie, J.C.; Lai, P.H.; Lin, F.K.; Strickland, T.; Watson, E.; Stebbing, N. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY

(1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

The successful cloning of the gene for human erythropoietin (EPO) has yielded information on the genetic organization and protein structure of this hormone and has allowed assessment of its biological properties. Biological studies have clearly indicated the clinical potential for this hormone in treatment of various anemias, and initial clinical studies of recombinant-DNA-produced human EPO are now under way. 43 references, 5 figures, 2 tables.

39203 (CONF-8906166–1) **Rubisco: Active-site characterization and mechanistic implications.** Hartman, F.C. Oak Ridge National Lab., TN (USA). 1989. 19p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From NATO Advanced Study Institute summer school of enzymatic and model carboxylation and reduction reactions for carbon dioxide utilization; Bari (Italy); 17-28 Jun 1989. Order Number DE89014066/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Diverse chemical methods and comparative sequence analyses have identified Lys-166, Lys-329, and Glu-48 of Rubisco as active-site residues and have suggested that these residues participate in catalysis. These conclusions have been validated by site-directed mutagenesis; furthermore, hybridization of distinct site-directed mutant proteins demonstrates an intersubunit location of the active site in which side chains from each subunit are required. The ability of mutant proteins, devoid of overall carboxylase activity, to catalyze certain partial reactions suggests that Lys-166 is the base that enolizes ribulose-P_2 and that Lys-329 facilitates addition of gaseous substrate to the enediol. 39 refs., 6 figs., 2 tabs.

39204 (DOE/ER/13693–3) **Cell signalling and phospholipid metabolism.** Boss, W.F. North Carolina State Univ., Raleigh, NC (USA). Dept. of Botany. [1989]. 5p. Sponsored by DOE Energy Research. DOE Contract FG05-87ER13693. Order Number DE89015093/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Our research for the past two years has involved the study of phosphoinositides and their potential role in regulating plant growth and development. Our initial goal was to document the sequence of events involved in inositol phospholipid metabolism in response to external stimuli. Our working hypothesis was that phosphatidylinositol bisphosphate (PIP_2) was in the plasma membrane of plants cells and would be hydrolyzed by phospholipase C to yield the second messengers inositol triphosphate (IP_3) and diacyglycerol (DAG) and that IP_3 would mobilize intracellular calcium as has been shown for animal cells. Our results with both carrot suspension culture cells and sunflower hypocotyl indicate that this paradigm is not the primary mechanism of signal transduction in these systems. We have observed very rapid, within 5 sec, stimulation of phosphatidylinositol monophosphate (PIP) kinase which resulted in an increase in PIP_2. However, there was no evidence for activation of phospholipase C. In addition, we have shown that PIP and PIP_2 can activate the plasma membrane ATPase. The results of these studies are described briefly in the paragraphs below. Inositol phospholipids are localized in distinct membrane fractions. If PIP and PIP_2 play a role in the transduction of external signals, they should be present in the plasma membrane. We used the fusogenic carrot suspension culture cells as a model system to study the distribution of inositol phospholipids in various membrane fractions and organelles. Cells were labeled 12 to 18 h with myo[2-^{3}H] inositol and the membranes were isolated by aqueous two-phase partitioning. The plasma membrane was enriched in PIP and PIP_2 compared to the intracellular membranes.

39205 (DOE/ER/60621–2) **Incision of uv irradiated DNA in yeast: Progress report, November 1, 1988–June 7, 1989.** Prakash, L. Rochester Univ., NY (USA). School of Medicine and Dentistry. Jun 1989. 5p. Sponsored by DOE Energy Research. DOE Contract FG02-88ER60621. Order Number DE89015499/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Our objectives are to determine the details of the incision step of excision repair following exposure to uv light in the eucaryotic organism, the yeast Saccharomyces cerevisiae. We have focused on three of the ten genes involved in this process – RAD1, RAD3, and RAD10. We have purified RAD3 protein to near homogeneity, and it possesses single-stranded DNA-dependent ATPase activity and DNA helicase activity which translocates in the 5' → 3' direction. Site-directed mutagenesis was used to change amino acid residues in a region thought to be required for nucleotide binding and the biological effects of these mutations determined. RAD1 protein is also being purified and RAD10 protein has been purified to near homogeneity. We can now begin to examine RAD10's role in excision repair. A conserved pattern of antisense overlapping transcription has been noted in the yeast RAD10 gene region and in the homologous human ERCC-1 gene. Analysis of the overlapping genes in this region has been carried out. The human RAD3 homolog ERCC-2 is also being studied. Since defective DNA repair and enhanced neoplasia characterize several human genetic diseases, a thorough understanding of the molecular mechanisms of DNA repair may provide a better understanding of the causes of carcinogenesis.

39206 (LA-UR–89-1989) **The human telomere.** Moyzis, R.K. Los Alamos National Lab., NM (USA). 1989. 14p. Sponsored by DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-8906159–2: 6. conversation in the discipline biomolecular stereodynamics, Albany, NY, USA, 6-10 Jun 1989). Order Number DE89014252/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An ultimate goal of human genetics is the generation of a complete physical and "functional" map of the human genome. Twenty-five percent of human DNA, however, consists of repetitive DNA sequences. These repetitive DNA sequences are thought to arise by many mechanisms, from direct sequence amplification by the unequal recombination of homologous DNA regions to the reverse flow of genetic information. A general outline of the chromosomal organization of these repetitive sequences will be discussed. Our working hypothesis is that certain classes of human repetitive DNA sequences "encode" the information necessary for defining long-range genomic structure. Evidence will be presented that the first goal of this research, the identification and cloning of the human telomere, has been achieved. A human repetitive DNA library was constructed from randomly sheared, reassociated, and oligo(G·C)-tailed DNA, a method that minimizes the potential loss of sequences devoid of a given restriction enzyme site. Sequences too large to clone efficiently in cosmid or λ vectors, such as centromeric repeats, or telomeric sequences with an end incompatible for cloning, should be present in this library. In order to isolate highly conserved repetitive DNA sequences, this library was screened with radiolabeled hamster Cot50 repetitive DNA. Two clones, containing tandem arrays of the sequence (TTAGGG), were isolated by this method. 30 refs., 1 fig., 2 tabs.

39207 (LA-UR–89-2198) **The Human Genome Program.** Bell, G.I. Los Alamos National Lab., NM (USA). 1989. 9p. Sponsored by DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-8906159–1: 6. conversation in the discipline biomolecular stereodynamics, Albany, NY, USA, 6-10 Jun 1989). Order Number DE89014273/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Early in 1986, Charles DeLisi, then head of the Office of Health and Environmental Research at the Department of Energy (DOE) requested the Los Alamos National Laboratory (LANL) to organize a workshop charged with inquiring whether the state of technology and potential payoffs in biological knowledge and medical practice were such as to justify an organized program to map and sequence the human genome. The DOE's interest arose from its mission to assess the effects of radiation and other products of energy generation on human health in general and genetic material in particular. The workshop concluded that the technology was ripe, the benefits would be great, and a national program should be promptly initiated. Later committees, reporting to DOE, to the NIH, to the Office of Technology Assessment of the US Congress, and to the National Academy of Science have reviewed these issues more deliberately and come to the same conclusion. As a consequence, there has been established in the United States, a Human Genome Program, with funding largely from the NIH and the DOE, as indicated in Table 1. Moreover, the Program has attracted international interest, and Great Britain, France, Italy, and the Soviet Union, among other countries, have been reported to be starting human genome initiatives. Coordination of these programs, clearly in the interests of

each, remains to be worked out, although an international Human Genome Organization (HUGO) is considering such coordination. 5 refs., 1 fig., 2 tabs.

39208 (LBL–24018, pp. 20) **Light regulation of nuclear and chloroplast nucleic acid synthesis in euglena gracilis.** Bartholomew, J.C. Lawrence Berkeley Lab., CA (USA). Sep 1987. In *Chemical Biodynamics Division: Annual report, October 1, 1986-September 30, 1987.* Order Number DE88004886/JAW. Available from NTIS, PC A04/MF A01.

Our research has been directed towards the understanding of the light control of expression of the many genes encoding the photosynthetic apparatus in the eukaryotic alga Euglena gracilis. While the photosynthetic processes are primarily carried out in the chloroplasts of eukaryotic photosynthetic cells, the genes encoding the components are distributed into both the nuclear and the chloroplast genomes. The mechanism(s) coordinating the expression of these physically separated genomes is not known. In most eukaryotic cells the nuclear pattern of gene expression is linked to the position of the cells in the cell cycle. In Euglena light has a dramatic effect on cell cycle traverse. Euglena placed on a 12 hr light - 12 hr dark regime will become synchronized in their traverse of the cell cycle. The relationship between the cell cycle response to light and the photosynthetic gene expression as a function of light is the subject of our investigations.

39209 (LBL–24018, pp. 22-25) **Plant biochemistry.** Rapoport, H. Lawrence Berkeley Lab., CA (USA). Sep 1987. In *Chemical Biodynamics Division: Annual report, October 1, 1986-September 30, 1987.* Order Number DE88004886/JAW. Available from NTIS, PC A04/MF A01.

The objectives of this project are to study the structure and mechanism of action of the non-chlorophyllous plant protein-pigment phytochrome. The specific aims of this project are: To determine the stereochemistry of the pigment-protein linkage in phytochrome; To determine the structural changes both in pigment and protein accompanying the change of phytochrome from the inactive P_R form to the active P_{FR} form; To establish the relative and absolute stereochemistry of the bilipeptide linkages; To synthesize the specific stereoisomers of S-cysteinylphytochromobilin; and To synthesize models of phytochrome consisting of pigment covalently attached to polypeptides of various lengths and composition in order to probe pigment-protein interactions.

39210 (LBL–24018, pp. 26-28) **Hydrocarbons from plants.** Calvin, M.; Otvos, J.W. Lawrence Berkeley Lab., CA (USA). Sep 1987. In *Chemical Biodynamics Division: Annual report, October 1, 1986-September 30, 1987.* Order Number DE88004886/JAW. Available from NTIS, PC A04/MF A01.

The overall goal of this program is to develop an understanding of the processes involved in hydrocarbon production in plants. Specifically, we are interested in the mechanisms and control of isoprenoid (terpenoid) biosynthesis. Acquiring this basic information will be necessary before we can genetically manipulate plants to increase hydrocarbon yields. We use the latex isolated from laticifer cells of the Euphorbia lathyris plant for our biosynthetic studies. These cells are the site of both the biosynthesis and the storage of large quantities of sterols (triterpenols). We are currently examining the final steps of sterol synthesis, the epoxidation and cyclization of squalence, to determine if more than one squalene cyclase is involved in sterol synthesis. We are also attempting to identify the organelle involved in the conversion of mevalonic acid (MVA) to sterols.

39211 (LBL–24018, pp. 33-34) **Biomolecular structure analysis by NMR.** Wemmer, D.E. Lawrence Berkeley Lab., CA (USA). Sep 1987. In *Chemical Biodynamics Division: Annual report, October 1, 1986-September 30, 1987.* Order Number DE88004886/JAW. Available from NTIS, PC A04/MF A01.

Our efforts this year have been directed to several problems of protein and oligonucleotide structure, and have used high resolution NMR spectroscopy extensively. The general goals of the projects described are: to understand the solution structure of DNA molecules with a nick or gap in the sugar phosphate backbone as simple models for damaged DNA; to determine the structure of a drug/DNA complex, and determine the microscopic kinetics of the binding steps; and to analyze the structures of several small cystine rich proteins to enhance our understanding of the active parts of the structure. A significant amount of time has gone into implementation of methods for preparing large quantities of specific sequence DNA oligomers for study, and to setting up the necessary software on our VAX computer systems for analysis of NMR data, and the required structure calculations. The results of these efforts are discussed for the following projects: gap DNA structures; DNA-drug binding and analysis of protein structures.

39212 (LBL–24018, pp. 39-41) **Control of DNA synthesis in human cells.** Bartholomew, J.C. Lawrence Berkeley Lab., CA (USA). Sep 1987. In *Chemical Biodynamics Division: Annual report, October 1, 1986-September 30, 1987.* Order Number DE88004886/JAW. Available from NTIS, PC A04/MF A01.

The genome of human cells contains approximately 10^9 nucleotide pairs organized into a particular sequence. The faithful replication of this amount of information into each daughter cells is obviously a formidable task. At each round of replication not only must the sequence of the DNA be preserved, but also the complement of genetic information must be maintained. A great deal of work has focused on the mutational aspects of sequence changes, but little is known about the stability of the genome. A clue as to how the genome sequence is normally maintained in such a highly organized state during DNA replication is to learn something about the factors that destabilize the replication of the genome. Our research program centers on the hypothesis that much of the control of genome stability takes place at the level of initiation of DNA replication within sections of the genome. If initiation of DNA synthesis in a section of the genome occurs more than once per cell cycle, the extra copies of this section are available for gene amplification and/or rearrangement. We are interested in understanding what cellular factors regulate this initiation, and how external environmental stresses modulates the initiation of DNA synthesis at these sites.

39213 (LBL–24018, pp. 41-45) **Structural biology.** Kim, S.H. Lawrence Berkeley Lab., CA (USA). Sep 1987. In *Chemical Biodynamics Division: Annual report, October 1, 1986-September 30, 1987.* Order Number DE88004886/JAW. Available from NTIS, PC A04/MF A01.

Two major projects currently on going are: (1) Structure determination of one of the most common human oncogene products, ras oncogene products (p21 proteins); and (2) Structure determination of DNA damaged by a mutagen and UV radiation using NMR and x-ray crystallography. There is compelling evidence that human cancer develops as a consequence of genetic changes (probably multiple) is some members of a selected set of cellular genes. DNA isolated from a variety of tumors, but not normal tissues, possesses the ability to malignantly transform non-tumorigenic cells. Subsequently, many oncogenes responsible for such transformation have been isolated from human tumors and cell lines, and spontaneous, virus, chemical, or radiation-induced animal tumors. We have utilized two-dimensional NMR spectroscopy to analyze experimentally the solution structure of a self-complementary DNA octanucleotide, d-GGGTACCC, cross-linked with psoralen. This DNA contains a central 5'-TpA sequence which has been shown to be highly reactive with psoralens.

39214 (LBL–24018, pp. 48-53) **National tritium labeling facility.** Rapoport, H. Lawrence Berkeley Lab., CA (USA). Sep 1987. In *Chemical Biodynamics Division: Annual report, October 1, 1986-September 30, 1987.* Order Number DE88004886/JAW. Available from NTIS, PC A04/MF A01.

This laboratory is a national facility both for carrying out research into the labeling of compounds to high specific activity with tritium as well as for providing a tritium labeling service for other investigators throughout the country. A primary direction this laboratory is moving into in the future is the development of compounds and techniques to allow ^3H NMR studies of biological macromolecules. The establishment of the National Tritium Labeling Facility at LBL, under the sponsorship of the NIH, provides the setting for pursuing exciting new research in structural biology and biophysics. In particular, we propose the use of tritium to expand the molecular weight range of biomolecules that can be studied by Nuclear Magnetic Resonance methods. Amino acids and nucleic acid bases will be selectively tritiated and then specifically incorporated into respective protein and nucleic acid sequences. As the triton is magnetically

distinct from the proton and will always be dilute, the spectrum will be simple, the assignment of spectral features straightforward and the interpretation of the structural and dynamic aspects more site specific than has been possible heretofore. As there is no natural background signal, observation of the ^3H NMR spectra of triated substrates, in vivo, provides other opportunities for studying dynamic properties of enzymatics, cellular transport and metabolism.

39215 (LBL–24018, pp. 54-55) **DOE sponsored university contract.** Tinoco, I. Jr. Lawrence Berkeley Lab., CA (USA). Sep 1987. In *Chemical Biodynamics Division: Annual report, October 1, 1986-September 30, 1987.* Order Number DE88004886/JAW. Available from NTIS, PC A04/MF A01.

Left-handed Z-RNA was discovered in our laboratory in 1984; it was the first new double-helical structure found for RNA since right-handed A-RNA was described in the 1950s. The Z-RNA conformation occurred when a polyribonucleotide with a sequence of alternating cytosines and guanines (poly r(C-G)) was placed in highly concentrated aqueous solutions of salts (6 M NaBr or $NaC1O_4$). The most important questions to ask about a new structure for a biological molecule are: (1) Does the structure exist in nature? (2) Does it have a biological function? We have made antibodies against left-handed Z-RNA to provide answers to these questions. A microscope which produced images dependent only on linear dichroism or on circular dichroism of the object has been developed. This provides sensitive new ways of looking at cells which do not require fixation and staining. Two biological systems are being studied with this microscope: erythocytes from patients with sickle cell disease and spermatocytes from Drosophila. Study of the thermodynamics and structures of DNA double helices containing base-base mismatches (non-Watson-Crick base pairs) is continuing in this laboratory.

39216 (PNL-SA–16764) **Using molecular dynamics simulations of crambin to evaluate the suitability of different continuum dielectric models for protein simulations.** Ornstein, R.L. Pacific Northwest Lab., Richland, WA (USA). Jun 1989. 12p. Sponsored by DOE Energy Research. DOE Contract AC06-76RL01830. (CONF-8906159–3: 6. conversation in the discipline biomolecular sterodynamics, Albany, NY, USA, 6-10 Jun 1989). Order Number DE89014921/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Molecular mechanics and dynamics computations of charge-charge interactions for proteins usually involve either a microscopic description of solvent or a continuum dielectric model. In theory the former are superior, but continuum models are thought to incorporate the essence of the underlying physics and are much more computationally practical for proteins. The choice of continuum models is, however, often arrived at largely by intuition rather than by objective empirical criteria. Others have suggested that simple continuum models often overestimate interactions at the protein surface, while underestimating interactions at the interior. The present calculations were performed with a variety of continuum models and neutral partial charges on the ionic residues, which tend to be solvated on the surface of proteins. Because of its small size and well resolved x-ray crystal structure, crambin has been the focus of previous attempts to explore the role of dielectric and other model parameters on its computed structure and stability. We now perform a series of 100 picosecond molecular dynamics simulations on crambin in order to examine how well computed structures, obtained using different simple continuum models, agree with the x-ray structure. A constant dielectric of 1.0 and a linear dielectric model of 1r yield low energy structures that agree with the crystal structure to within an RMS deviation of 1.67A, for the backbone atoms, throughout the 100 picosecond simulations at 300K. Several other dielectric models were found to yield significantly poorer fits. The above trend does not semi-quantitatively converge until about 50 picoseconds into the simulations; these results suggest that similar studies based on energy minimizations or shorter simulations should be viewed with caution. 34 refs., 2 figs., 1 tab.

39217 Application of high-resolution, two-dimensional electrophoresis to the analysis of wheat, milk, and other agricultural products. Anderson, N.G. (Proteus Technologies, Inc., Rockville, MD (US)); Anderson, N.L. v.v of New directions in electrophoretic methods. Jorgenson, J.W.; Phillips, M. American Chemical Society, Washington, DC (1987). (CONF-850942–: 190. American Chemical Society national meeting, Chicago, IL, USA, 8-13 Sep 1985).

High-resolution two-dimensional electrophoresis allows hundreds of proteins to be separated and characterized in submilligram samples of complex protein mixtures. Applications of this method to the analysis of agriculturally important products, including milk, meat, and wheat are reviewed. In a model study the authors analyzed 100 individual kernels of the wheat cultivar Newton (Triticum aestivum L.) for electrophoretic variants. One variant protein was found in 47 kernels, while three variant proteins occurred together in two of the kernels. The implications of two-dimensional electrophoresis for cultivar identification and the problem of relating electrophoretic protein variants to genetic variants are discussed.

39218 Nickel site of methane catalysis in the methyl reductase enzyme. Shelnutt, J.A. (Sandia National Laboratories, Albuquerque, NM (USA)); Shiemke, A.K.; Scott, R.A. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 32(3): 272-279 (1988). DOE Contract AC04-76DP00789. (CONF-870802–: 194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug - 4 sep 1987).

Methyl reductase is the enzyme of methanogenic bacteria that catalyzed the two-electron reduction of the methyl group of 2-(methylthio)ethanesulfonic acid (methyl-S-CoM) to methane and HS-CoM. The methyl group of methyl-S-CoM ultimately comes from the six-electron reduction of CO_2 by hydrogen, which also provides the reducing equivalents needed by methyl reductase. The nature of the catalytic site of methyl reductase is of current interest from the point of view of developing biomimetic C_1, chemistries directed toward methane synthesis and activation. In particular, Sandia is using molecular graphics and energy optimization techniques to design macromolecular catalysts that mimic the structure of sites of proteins that carry out C_1 chemistry. The goal is to produce catalysts whose function is the oxidation of low molecular weight hydrocarbon gases to generate liquid fuels or, alternatively, the reduction of abundant inorganic resources such as CO_2 to generate gaseous fuels. Unfortunately, the catalytic sites of many of the enzymes of interest, e.g., methyl reductase and methane monooxygenase, have not been characterized by X-ray crystallography and other structural techniques. With the goal of learning more about the structure of one of these naturally occurring sites of C_1 chemistry, we have obtained the first resonance Raman spectra of the nickel-macrocycle, called F_{430}, at the site of catalysis in methyl reductase. To help us structurally interpret the Raman spectra of the enzyme we have also obtained Raman spectra of solutions of the major forms of F_{430} (salt-extracted and cytosol-free) at room temperature and at 77°K and also, under similar solution conditions, spectra of a nickel-corphinoid derivative that is related to F_{430}.

39219 *In situ* **determination of induced dipole moments of pure and membrane-bound retinal chromophores.** Rasing, T. (Department of Physics, University of California, Berkeley, California 94720(US)); Huang, J.; Lewis, A.; Stehlin, T.; Shen, Y. R. *Physical Review [Section] A: General Physics (USA),* 40(3): 1684-1687 (1 Aug 1989). DOE Contract AC03-76SF00098.

By using the technique of optical second-harmonic generation, we havesucceeded in obtaining the orientation, spectrum, and the change in dipolemoment upon optical excitation for monolayers of retinal chromophores, whichare of relevance for visual excitation. The change in dipole moment of thechromophore embedded in the purple membrane of *Halobacterium halobium* isfound to be identical to that of the free chromophore. The spectrum ofall-trans retinal monolayers exhibits a subsidiary one-photon forbidden peak inaddition to the main absorption peak.

39220 Electromicroinjection of particles into living cells. Ray, F.A.; Cram, L.S.; Galey, W.R. To Dept. of Energy, Washington, DC. USA Patent 4,784,737. 15 Nov 1988. Filed date 18 Apr 1986. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

Method and apparatus are described for introducing particles into living cells. Fluorescently-stained human chromosomes are introduced into cultured, mitotic Chinese hamster cells using electromicroinjection. The recipient cells frequently survived the physiological perturbation imposed by a successful chromosome injection. Successfully injected recipient cells maintained viability as

evidenced by their ability to be expanded. The technique relies on the surface charge of fluorescently stained chromosomes and their ability to be attracted and repelled to and from the tip of a micropipette. The apparatus includes a micropipette having a tip suitable for piercing the membrane of a target cell and an electrode inserted into the lumen thereof. The target cells and suspended particles are located in an electrically conducted solution, and the lumen of the micropipette is filled with an electrically conducting solution which contacts the electrode located therein. A second electrode is also located in the conducting solution containing the target cells and particles.

5503 Cytology

Refer also to citation(s) 39220

5504 Genetics

Refer also to citation(s) 38296, 38297, 38298, 38299, 38300, 39178, 39179, 39180, 39184, 39190, 39205, 39207, 39220, 39264, 39265, 39266, 39276

39221 Human genetics: the molecular challenge. Bodmer, W.F. (Imperial Cancer Research Fund, London (England)). pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

The complexity of the human genome is no longer beyond the grasp of molecular biology. The number of different gene products may be no more than 50,000 to 150,000, divided into a maximum of perhaps 10 to 15,000 families of related products, many of which may themselves be part of related super-families. This means that in the foreseeable future we may be able to identify the complete set of genetic functions that contributes to any phenotype, be it a behaviour or a cancer. Knowing where genes are on the genetic map can make a major contribution to sorting out gene-function relationships. Polymorphic DNA probes now provide an essentially unlimited range of genetic markers for the search for linkage with well-defined Mendelian traits such as familial polyposis coli, or for the identification of genetic factors in less well-defined susceptibilities such as heart disease or cancer. Simply searching for a distortion in the expected Mendelian segregation pattern amongst family members sharing a trait can identify the location of a gene involved in determining the trait. The HLA system, which is associated with a variety of chronic diseases with immune aetiology, is a good model for such analyses. It also illustrates the complex evolution of a gene cluster, and the importance of the distinction between genetic marker associations in families and in populations. The ultimate challenge is to unravel the genetic contributions at the molecular level to the determination of common traits, including the major chronic diseases, heart disease, autoimmune disease and cancer, as well as to normal variations, for example in physical features and behaviour. 29 references, 3 figures, 1 table

39222 Gene map of homo sapiens: status and prospectus. McKusick, V.A. (Johns Hopkins Univ. School of Medicine, Baltimore, MD (USA)). pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

The chromosome carrying each of about 900 genes. Many of these genes have been fairly precisely localized. This is less than 2% of the estimated 50,000 genes for man. About 500 anonymous DNA segments have also been mapped; many of these have sequence variation useful as linkage markers. The information has revealed frequent clustering of genes of related function and extensive homology of synteny even with species as remote as the mouse. In general the subunits of heteromeric proteins are coded by different chromosomes; mitochondrial and cytosolic isozymes are coded by different chromosomes; and genes encoding enzymes in the same metabolic pathway are usually not syntemic. The gene map has played an important role in validation of the chromosome theory of cancer; viz., specific morphologic changes in the chromosomes consistently associated with particular neoplasms and the correlation of these changes with the location of oncogenes and of specific changes in DNA. Most cancers are somatic cell genetic diseases. Many congenital malformations and autoimmune diseases may be somatic cell genetic diseases. Mapping may help in the understanding of these also. Mapping is important to diagnosis by the linkage principle. It is also important to delineation of the basic defect by reverse genetics (going to the DNA pinpointed by the mapping) and by the candidate gene approach: Is the disease phenotype linked to a RFLP of a given cloned gene? Does the disease phenotype map to the same region as a candidate gene? Complete sequencing of the human genome will build on complete mapping of the structural genes of man. The dimensions of the task and the information it will engender are useful to consider. 94 references, 3 tables.

39223 Construction of human genetic linkage maps. I. Progress and Perspectives. White, R. (Univ. of Utah School of Medicine, Salt Lake City (USA)); Leppert, M.; O'Connell, P.; Nakamura, Y.; Julier, C.; Woodward, S.; Silva, A.; Wolff, R.; Lathrop, M.; Lalouel, J.M. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

As the number of genetic markers which can be defined at the molecular level increases, extensive linkage groups that cover entire chromosomes will be developed. Construction of linkage maps requires that genotypes be characterized on a common panel of families of optimal structure. By following Mendelian segregations at several loci jointly, new and powerful analytical strategies can be brought to bear for the detection of linkage, the estimation of recombination, and the determination of gene order. As human linkage maps expand, new multilocus strategies become necessary to add a new locus to a genetic map and to meet the computing challenge resulting from the large number of possible genetic outcomes which have to be accounted for. Current experience will serve to illustrate these points and to highlight areas where further methodological advances are needed. 17 references, 9 figures, 1 table.

39224 Construction of human genetic linkage maps. II. Methodologies issues. Lalouel, J.M. (Univ. of Utah Medical Center, Salt Lake City (USA)); Lathrop, G.M.; White, R. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

When genes are assigned to chromosomes or to chromosome subregions through somatic cell hybrids or in situ hybridization the map generated is strictly physical. So it is for molecular maps generated on particular genomic regions by restriction mapping of overlapping DNA sequences, and so will it be when extensive restriction maps are constructed with pulsed-field gel electrophoresis. By contrast, genetic maps constructed by analysis of the segregations at two or more loci are determined by the distribution of crossing-over in all intervals considered. The occurrence of crossing-over is not uniform with respect to distance on the physical map, so no monotonic relationships liquid be expected between physical and genetic maps. This discussion bears on methodological aspects of the construction of genetic maps in human. Together with the detection of genetic linkage and the estimation of recombination between a set of loci in appropriate familial data, the construction of genetic maps requires that the order of the genes be inferred from the observed recombination values. This enterprise presents various challenges that will call for carefully designed strategies and analytical methods. We try here to convey our interest in meeting these challenges without undue mathematical arguments, at the risk of over simplification for the statistically minded reader. 26 references, 8 figures, 5 tables.

39225 Mapping complex genetic traits in humans: new methods using a complete RFLP linkage map. Lander, E. (Nine

Cambridge Center, MA (USA)); Botstein, D. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

It may appear that the vast majority of human heredity must remain refractory to genetic mapping, due to complexity or rarity. On the contrary, it is the main thesis of this paper that this need not be so. The important point is that studying the segregation patterns of a large number of mapped RFLPs simultaneously, rather than one at a time, can make it feasible to map many traits that are genetically complex and/or rare. We discuss here new mathematical techniques, unusual genetic resources, and clinical approaches that can potentially be brought to bear on the problem. 34 references, 8 figures.

39226 Human major histocompatibility complex genes: class I antigens and tumor necrosis factors. Strominger, J. (Harvard Univ., Cambridge, MA (USA)). pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

Two topics relating to genes of the human major histocompatibility complex (MHC) are discussed. They are the use of cytotoxic T lymphocyte variants and site-directed mutagenesis to map functional sites in class I MHC molecules and the regulation of expression of class I genes by tumor necrosis factor (TNF) and the fact that TNFα and the closely related lymphotoxin (TNFβ) are themselves encoded in the MHC. 6 references, 2 figures.

39227 Polymorphism and regulation of HLA class II genes of the major histocompatibility Complex. Mach, B. (Univ. of Geneva Medical School (Switzerland)); Gorski, J.; Rollini, P.; Berte, C.; Amaldi, I.; Berdoz, J.; Ucla, C. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

The diversity of major histocompatibility complex (MHC) antigens results from allelic polymorphism at the population level, with all cells of a given individual expressing the same specificity. The MHC encodes two major groups of antigens: class I, also known as transplantation antigens, and class II, involved in the control of the immune response. This paper addresses the characteristic features of MHC class II antigens and indicates their biological and medical importance. HLA class II, or Ia, antigens are highly polymorphic molecules encoded in the MHC. They consist of α and β chains forming a transmembrane, glycosylated heterodimer. The key function of class II antigens is in the interaction of an antigen-presenting cell and T lymphocytes. MHC class II genes also control the extent of an immune response to individual foreign antigens; they are thus referred to as immune response genes. Different alleles of these genes encode different effectiveness in the presentation of individual antigens, this results in either a high or a low level of immune response. The different loci encoding class II genes are tightly linked, and one frequently observes a linkage disequilibrium in the expression of individual alleles at different loci. Finally, a medically important observation is the existence of a striking association between the susceptibility to certain important diseases, such as diabetes, and certain specific HLA class II haplotypes. 29 references 8 figures.

39228 Molecular biology of the class II region of the human major histocompatibility complex. Bell, J.I. (Stanford Univ. School of Medicine, CA (USA)); Denney, D.; Foster, L.; Lee, B.S.M.; Hardy, L.D.; McDevitt, H.O. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

The class II region of the human major histocompatibility complex (MHC) consists of at least 14 loci clustered together on the short arm of chromosome 6. Although these loci have all been identified, no comprehensive map order of the human class II region is available. The development of a technique for studying large genomic DNA fragments (>100 kb) with pulsed-field gradient gel electrophoresis has permitted the mapping of the loci of this region. Classically, the polymorphism within this region has been defined serologically and with the mixed lymphocyte reaction. The use of two-dimensional gel electrophoresis, in conjunction with monoclonal antibodies, has also contributed to our knowledge of the polymorphism of this region. The development of molecular biological approaches for studying this polymorphism has recently permitted the characterization of previously undetected polymorphism. Most fruitful has been the use of restriction-fragment-length polymorphisms to study variation within populations, and allelic nucleic acid sequencing of cDNA clones, which has permitted a more precise description of the polymorphism. We have used these techniques first to study the polymorphism present in the normal population and then to extend these studies to patients with diseases associated with serologically defined class II polymorphism. 31 references 6 figures.

39229 HLA class II RFLPs are haplotype-specific. Serjeantson, S.W. (Australian National Univ., Canberra); Kohonen-Corish, M.R.J.; Dunckley, H.; Reid, M.A. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

The marked linkage disequilibrium between the HLA-B and -DR loci in the major histocompatibility complex of man is considered indirect evidence for the importance of natural selection in the evolution of this region of the genome. These studies show that linkage disequilibrium values for HLA-B and -DR, based on serological techniques, are gross under-estimates of the strength of the HLA-B and DR linkage relationships. RFLPs in HLA-DRα DRβ, DQα and DQβ were generated with five different restriction enzymes in a panel of 250 cells and revealed heterogeneity within DR types that was haplotype specific. Following the method developed by R. A. Fisher to predict the order of the Rhesus blood group genes, the class II RFLPs and their linkage relationships with HLA-B are used to predict the order and orientation of the DQ and DR α and β chain genes. 45 references, 7 tables.

39230 Approaches to physical mapping of the human genome. Smith, C.L. (Columbia Univ., New York, NY (USA)); Cantor, C.R. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

Four techniques have been developed that together should make it possible to begin to construct a coarse restriction map of the human genome. Each technique was developed on yeast or bacteria and has been shown to be feasible for comparable studies on human samples. High molecular weight DNA samples can be prepared by cell lysis in situ in agarose and extensive protease, detergent and salt treatments. These samples can be cut into discrete large DNA fragments in situ by treatment with various restriction nucleases. Appropriate choice of enzymes can yield fragments averaging anywhere from a few hundred kB in size to more than a thousand kB. Pulsed field gel electrophoresis affords excellent separations of these large fragments of human DNA. The electrophoretic separations can be visualized by ordinary Southern blotting and hybridization with cloned single copy probes. In this way, large genomic DNA fragments encompassing any desired known small DNA sequence can be identified. For construction of physical maps, several different enzyme digests can be overlapped. More efficient strategies have also been designed that take unique advantage of the availability of large DNA fragments. For example, it is possible to select from a library just those junction clones that

contain a rare restriction enzyme cutting site. Probing a genomic digest of DNA generated by the same enzyme will reveal two large fragments. These must be adjacent, and thus a physical map of the distances between all rare cutting sites can be generated systematically, by combining his approach with the use of other specially selected libraries. 20 references, 5 figures, 2 tables.

39231 Molecular approaches to mammalian genetics. Poustka, A. (European Molecular Biology Laboratory, Heidelberg (Germany, F.R.)); Pohl, T.; Barlow, D.P.; Zehetner, G.; Craig, A.; Michiels, F.; Ehrich, E.; Frischauf, A.M.; Lehrach, H. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

Chromosome jumping was designed to overcome the inherent limitation of the step size by the capacity of available cloning vectors. To take steps larger than the maximal size of clonable DNA, the size of large fragments is first reduced by an internal deletion, leaving the ends of the fragments intact. The large DNA restriction fragments produced are circularized in the presence of a selectable marker under conditions designed to maximize intramolecular ligation reactions. Circularized molecules are cleaved with another restriction enzyme cleaving the circle into many fragments, and the junction fragments are selectively cloned. Chromosome jumping is inherently directional, that is, one always jumps from the first enzyme site in the direction of the second enzyme site used for library construction. This paper describes the construction of libraries made from DNA fragments generated by digestion with NotI that cut only rarely in mammalian DNA. The required complexity of such libraries is determined by the number of restriction sites for the corresponding restriction enzymes in the genome. Thus the use of enzymes that recognize a small number of sites should simplify both construction and screening of these libraries by two to three orders of magnitude compared with enzymes that cut more frequently. 20 references, 8 figures.

39232 Flow karyotyping and sorting of human chromosomes. Gray, J.W. (Lawrence Livermore National Laboratory, CA (USA)); Lucas, J.; Peters, D.; Pinkel, D.; Trask, B.; van den Engh, G.; Van Dilla, M. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). DOE Contract W-7405-ENG-48. From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

Flow cytometry and sorting are becoming increasingly useful as tools for chromosome classification and for the detection of numerical and structural chromosome aberrations. Chromosomes of a single type can be purified with these tools to facilitate gene mapping or production of chromosome-specific recombinant DNA libraries. For analysis of chromosomes with flow cytometry, the chromosomes are extracted from mitotic cells, stained with one or more fluorescent dyes, and classified one by one according to their dye content(s). Thus, the flow approach is fundamentally different than conventional karyotyping, where chromosomes are classified within the context of a metaphase spread. Flow sorting allows purification of chromosomes that can be distinguished by flow cytometry. We describe here the basic principles of flow cytometric chromosome classification (flow karyotyping) and chromosome sorting, and we describe several recent applications. In addition, we present recent developments in slit-scan flow cytometry and high-speed flow sorting that promise to improve chromosome classification and purification. 28 references, 8 figures.

39233 Construction of human chromosome-specific DNA libraries from flow-sorted chromosomes. Deaven, L.L. (Los Alamos National Lab., NM (USA)); Van Dilla, M.A.; Bartholdi, M.F.; Carrano, A.V.; Cram, L.S.; Fuscoe, J.C.; Gray, J.W.; Hildebrand, C.E.; Moyzis, R.K.; Perlman, J. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). DOE Contract W-7405-ENG-36. From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

The Los Alamos and Lawrence Livermore National Laboratories' biomedical research groups are currently constructing chromosome-specific DNA libraries from each of the human chromosomes. These libraries are available to the international scientific community to aid investigators in studies of gene mapping, genetic disease diagnosis, linkage and pedigree analysis and related areas of research. Chromosomes are isolated from normal human fibroblasts and human lymphoblastoid cells (#13 and smaller) or from Chinese hamster-human hybrids (#1-12) for flow sorting. DNA from flow sorted chromosomes is digested to completion with Eco R1 and Hind III and cloned into Charon 21A. Thus, the first libraries will consist of two complete sets, each in the same vector, but from cuts with different restriction enzymes. Library purity is determined by flow histogram analysis, cytogenetic analysis of sorted chromosomes, and analysis of cloned DNA. Each of the 24 human chromosomal types has been sorted, and libraries have been constructed for at least one restriction cut for each chromosome except number 1. These libraries are currently available from the American Type Culture Collection, Rockville, MD. 33 references, 5 figures, 5 tables.

39234 Flow-sorting analysis of normal and abnormal human genomes. Lebo, R.V. (Univ. of California, San Francisco (USA)); Anderson, L.A.; Lau, Y.F.C.; Flandermeyer, R.; Kan, Y.W. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

Flow analysis of human chromosomes is a powerful new approach to study the human genome. We have applied this technique to map genes, detect abnormal chromosome constitutions, and construct individual recombinant chromosomal DNA libraries. The dual-laser sorter can separate all the human chromosomes except 10 and 11. Individual chromosomes are sorted directly onto filter paper and hybridized to radiolabeled gene probe. Chromosomes from cell lines with appropriate translocations and deletions are used to localize genes subchromosomally. With these methods, we have located 37 recently cloned genes. When homologous gene sequences such as ferritin-L and von Willebrand factor are located on different chromosomes, Southern blot analysis of sorted chromosomal DNA directly assigns the genes to specific chromosomes. Flow analysis can detect altered chromosome frequencies and abnormal chromosomes with a 10% change in total DNA content. We have examined 11 clinical samples with deletions, insertions, translocations, and aneuploidy and found excellent agreement with results obtained by Giemsa-banded karyotypes. These results indicate that flow cytogenetics is potentially useful for patient screening. 34 references, 7 figures, 1 table.

39235 Reduced recombination rate on chromosomes 21 that have undergone nondisjunction. Antonarakis, S.E. (Johns Hopkins Univ. School of Medicine, Baltimore, MD (USA)); Chakravarti, A.; Warren, A.C.; Slaugenhaupt, S.A.; Wong, C.; Halloran, S.L.; Metaxotou, C. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

The purpose of this study is to test the hypothesis that asynapsis has occurred on chromosomes 21 that undergo nondisjunction. We have used several DNA polymorphisms as chromosome 21 markers in families with a Down syndrome child and developed new methods for linkage analyses of these markers on chromosomes that undergo nondisjunction and on chromosomes that disjoin normally, both from control families and from Down syndrome families. These studies show that chromosomes that have participated in nondisjunction demonstrate reduced recombination when compared with chromosomes that disjoin normally. These findings support the hypothesis that asynapsis, probably due to defective pairing of chromosomes 21 in the first meiotic division, is an etiologic factor that leads to trisomy 21. 39 references, 1 figure, 6 tables.

39236 Genetic recombination and disease. Siniscalco, M. (Memorial Sloan-Kettering Cancer Center, New York, NY (USA)). pp. 702 of Cold Spring Harbor symposia on quantitative biology.

Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

This report deals primarily with genetic recombination, both legitimate and illegitimate, along the sex chromosomes. Legitimate recombination occurs between the two X chromosomes at ovogenesis or between the homologous portion of the X and Y at spermatogenesis; illegitimate recombination may occur in either female or male gametogenesis, leading respectively to X-linked mutations of the duplication/deletion type or to the formation of zygotes with an altered sex phenotype. The focus is on the role of genetic recombination in the generation of human disease. 30 references.

39237 Genetic mapping of the human X chromosome: linkage analysis of the q26-q28 region that includes the fragile X locus and isolation of expressed sequences. Mandel, J.L. (Faculte de Medicine, Strasbourg (France)); Arveiler, B.; Camerino, G.; Hanauer, A.; Heilig, R.; Koenig, M.; Oberle, I. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

The X chromosome is probably the most studied of all human chromosomes, in part because more than 115 diseases show X-linked inheritance, because of the relative ease of linkage analysis, and because of the interest in diagnostic applications, since these diseases can appear in successive or collateral generations within a family. About 70 polymorphic DNA markers have been isolated and partially characterized. We have concentrated our efforts on the q26-q28 region because associated with it is the fragile X mental retardation syndrome. We have established the structural basis for the polymorphism at the hypervariable locus DXS52, which is closely linked to hemophilia A. We have determined the order of seven polymorphic markers around the fragile X locus (FRAX). The genetic distances between markers in this region suggest that recombination is not evenly distributed. At present, the markers most closely linked to FRAX (DXS52 and the coagulation factor IX gene F9) map at 10-15 cM from the disease locus, and there is evidence for heterogeneity in the genetic distance between F9 and FRAX in different families. We have also searched for expressed X-linked sequences since a map of such sequences might allow one to correlate a disease locus with a cloned gene located in the same region. We have partially characterized several X-linked genes and pseudogenes. We show that evolutionary considerations can be used fruitfully in this approach, to distinguish X-linked genes from X-linked pseudogenes, and to find expressed sequences within randomly cloned genomic fragments by searching for homologies with rodent genomes. The comparison of the homologous human and rodent sequences allows one to characterize putative protein-coding regions, even though the corresponding mRNA has not yet been detected. This should be useful in genome walking strategies designed to isolate a disease gene. 45 references, 5 figures, 2 tables.

39238 Molecular genetics of MIC2: a gene shared by the human X and Y chromosomes. Darling, S.M. (Laboratory of Human Molecular Genetics, London (England)); Goodfellow, P.J.; Pym, B.; Banting, G.S.; Pritchard, C.; Goodfellow, P.N. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

In immunoblot analysis the 12E7 antibody reacts strongly with a 32-kD human-specific cell-surface molecule. The antibody also recognizes a 29-kD cytoplasmic molecule found in both mouse and human cells. In situ hybridization using the MIC2 cDNA clone has further localized MIC2X to Xp22.32-pter, the terminal region of the X-chromosome short arm, and the MIC2Y locus has been assigned to the Y-chromosome short arm in the distal region Yp11.2-pter. Recombination between the X and Y chromosomes may be required for correct segregation of the sex chromosomes at meiosis. Depending on the position of recombination events, genes and DNA sequences present in the shared region will show only partial sex linkage if occasionally exchanged, or no sex linkage if frequently exchanged (pseudoautosomal). The assignment of the MIC2X and MIC2Y loci to the pairing region, the apparent identity of the X and Y products, and the inability to detect differences at the DNA level between MIC2X and MIC2Y suggested that they are a pair of pseudoautosomal genes. Consistent with this suggestion, the X-located MIC2 gene escapes X inactivation. We describe here a partial amino acid sequence deduced from the longest open reading frame in a cDNA clone derived from an MIC2 gene. A monoclonal antibody has been raised against a synthetic peptide based on part of the deduced sequence. This antibody reacts with the cell-surface product of the MIC2 genes. The cDNA clone and corresponding genomic clones have been used in family studies, and we have found a low frequency of exchange of MIC2 genes between the sex chromosomes. We conclude that the MIC2 gene is the first pseudoautosomal gene to be described in man. Finally, we describe experiments designed to exploit the chromosomal location of the MIC2 gene for exploring the region of the Y chromosome responsible for sex determination. 51 references, 2 figures, 3 tables.

39239 Variability at the telomeres of the human X/Y pseudoautosomal region. Cooke, H.J. (MRC Mammalian Genome Unit, Edinburgh (England)); Smith, B.A. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

The study of human telomeres is in its infancy compared with our knowledge of telomeres of lower eukaryotes. Both yeast and human telomeres have associated, complex repeated sequences that show extreme variation in the population. The human XY telomeric sequences in male meiosis are in a region of the genome that exhibits a recombination rate 10 times that found in the same region in female meiosis. It seems likely that this high recombination frequency in the pseudoautosomal region will provide at least a partial explanation for the variability seen in these sequences. 16 references, 9 figures.

39240 Pseudoautosomal region of the human sex chromosomes. Rouyer, F. (Institut Pasteur, Paris (France)); Simmler, M.C.; Vergnaud, G.; Johnsson, C.; Levilliers, J.; Petit, C.; Weissenbach, J. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

In man, several DNA loci have been mapped to the tip of the X- and Y-chromosome short arms. Alleles from such loci can be exchanged between both sex chromosomes in male meiosis. A first analysis of three distinct pseudoautosomal DNA loci performed on about 50 meioses has shown that such loci are each partially linked to sex, according to a gradient increasing from the non-sex-linked telomere to the more proximal loci. These results are consistent with a single and obligatory crossover between the human X and Y chromosomes and indicate that this event is not uniquely localized. We have now extended this quantitative analysis to five pseudoautosomal DNA loci in more than 100 male and female meioses. The sex-linkage gradient can vary from no linkage at all at the pseudoautosomal telomere to nearly absolute linkage for the more proximal loci. In addition, pseudoautosomal recombination is characterized by absence of double crossover and by a 10-fold to 20-fold increase of recombination frequency in male vs. female meiosis. These features add strong support to the view that the crossing-over taking place at male meiosis between the X and Y chromosomes is a single and obligatory event. 34 references, 5 figures, 3 tables.

39241 Sex reversal: deletion mapping the male-determining function of the human Y chromosome. Page, D.C. (Whitehead Institute for Biomedical Research, Cambridge, MA (USA)). pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

An 8-interval deletion map of the human Y chromosome has been constructed using DNA hybridization to characterize naturally occurring structural abnormalities. The map is oriented with respect to the short and long arms, and the position of the centromere is known. Within the normal population there may occur two Y chromosomes that differ by an inversion within the short arm. Y-DNA studies have reconciled many cases of gonadal sex reversal with the rule that the human Y chromosome is male-determining. Gonadal sex is determined according to the presence or absence of interval 1 which is on the short arm of the Y chromosome. XX males are the result of X;Y translocations that occur during or prior to meiosis in the fathers. Some XY females may carry the reciprocal product of similar X;Y translocations. Not all cases of gonadal sex reversal can be explained on the basis of Y-chromosome aberrations, and these provide evidence of genes that function downstream of the testes determining factor. 42 references, 3 figures.

39242 Molecular approach to the study of the human Y chromosome and anomalies of sex determination in man. Seboun, E. (Institut Pasteur, Paris (France)); Leroy, P.; Casanova, M.; Magenis, E.; Boucekkine, C.; Disteche, C.; Bishop, C.; Fellous, M. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

Using Y specific probes from a human Y library DNA of 40 XX males has been studied. In 2/3rds of patients, the probes hybridized with an X chromosome used. Comparison of the hybridization patterns with DNA from patients bearing abnormal Y chromosomes allows us to assign most of the Y specific bands detected in XX males to the short arm of the Y chromosome. Direct in situ hybridization strongly supports the occurrence of Y short arm translocation to the distal short arm of one of the X chromosome in the XX male syndrome. The counterpart of such exchange was observed in few cases of 46 XY female. A probe, p49f, was used to detect an autosomal (chromosome 3) and a Y sequence (Yq11-23). This probe hybridizes with a 4kb testis specific mRNA, present in different species including man. The corresponding cDNA has also been characterized. Using in situ hybridization, the corresponding transcript are detected in male germ cells, late during spermatogenesis. 42 references, 10 figures, 3 tables.

39243 Genetic and molecular studies on 46,XX and 45,X males. De La Chapelle, A. (Univ. of Helsinki (Finland)). pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

The first significant finding that provided a hint as to the etiology of maleness without a Y chromosome was that some XX males had inherited their father's Xg allele while others had not. Based on X chromosomal RFLP's, most XX males have one paternal and one maternal X chromosome. In one case serological evidence indicated that the father had transmitted to his XX male son an X chromosome without the Xg but carrying the Yg gene that normally occurs in an Xg-like locus on the Y. DNA sequences specific for the Y chromosome occur in some 60% of XX males while in some 40% none of the Y-derived probes so far tested occur. Finally, by in situ hybridization Y chromosome-derived sequences occur on the tip of the short arm of one X chromosome in some XX males. The testis determining factor (TDF) which is normally located on the Y chromosome has not yet been characterized or isolated. Nevertheless data on XX males are consistent with the hypothesis that TDF is carried by the paternal X chromosome in some XX males. In others, including the rare familial cases, TDF may be carried on another chromosome. Alternatively another testis-determining mechanism is involved. In 45,X males the etiology must be different at least in those cases where the single X chromosome is maternal. In at least some 45,X males low-grade mosaicism involving a 46,XY cell line has been detected by cytogenetic and molecular studies, while in others, Y chromosome-derived material occurs elsewhere in the genome. 54 references, 4 figures.

39244 Recent advances in the development of methods for detecting single-base substitutions associated with human genetic diseases. Myers, R.M. (Univ. of California, San Francisco (USA)); Maniatis, T. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

Despite considerable effort, no general method capable of detecting all possible single-base mutations in human genomic DNA is currently available. However, two recently developed methods significantly increase the number of single-base mutations that can be detected. One method is based on the melting behavior of DNA and the use of denaturing gradient gel electrophoresis, and the other method is based on the susceptibility of single-base mismatches in RNA:DNA duplexes to ribonuclease cleavage. These methods should not only be useful for diagnosing the mutations directly responsible for specific genetic diseases, but also be valuable in identifying new single-base polymorphisms for genetic linkage studies. In this paper, we describe the development and application of these methods and discuss the advantages and limitations of each approach. 27 references, 8 figures.

39245 Molecular genetics and the basic defect causing cystic fibrosis. Williamson, R. (Univ. of London (England)); Bell, G.; Bell, J.; Bates, G.; Davies, K.A.; Estivill, X.; Farrall, M.; Kruyer, H.; Law, H.Y.; Lench, N. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

Recombinant DNA sequences are now available that allow the mapping of the entire human genome, but the first linkage to cystic fibrosis (CF) came using classical protein polymorphisms. The enzyme paraoxonase was previously shown to be loosely linked to CF, to be followed quickly by six cloned DNA sequences: pJ3-11, 7C22, COLIA2, and TCRB, 917, and met. Both pJ3-11 and met are very close genetically to the CF mutation and can be used for carrier detection and prenatal diagnosis in many informative families with a CF child. There is no evidence for heterogeneity of the CF locus. The collection of informative markers surrounding the CF locus is now sufficient to permit attempts to be made to isolate the defective gene using a combination of chromosome-mediated gene transfer, pulse-field gel electrophoresis, cosmid mapping, and chromosome walking techniques, although the difficulty of obtaining tissue in which the defect is known to be expressed remains a problem. 42 references, 2 figures.

39246 Mapping of the cystic fibrosis locus on chromosome 7. Tsui, L.C. (Univ. of Toronto, Ontario (Canada)); Zengerling, S.; Willard, H.F.; Buchwald, M. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

As the first step in our approach to the basic defect in cystic fibrosis (CF), we have initiated a CF linkage study using DNA markers defined by restriction-fragment-length polymorphisms (RFLPs). After screening a large number of markers, covering a significant portion of the human genome, we have discovered a linkage between CF and a randomly isolated DNA marker, D7S15. Subsequent localization of this DNA marker to chromosome 7 has established that CF is also on chromosome 7. This paper describes the experiments that first allowed us to demonstrate the linkage between CF and D7S15 and the subsequent analysis that provided further information on the location of CF on chromosome 7. 47 references, 4 figures, 4 tables.

39247 Molecular analysis of human X-linked diseases. Davies, K.E. (Institut fuer Humagenetik und Anthropologie, Freiburg (Germany, F.R.)); Ball, S.P.; Dorkins, H.R.; Forrest, S.M.; Kenwrick, S.J.; King, A.W.; Lavenir, I.J.D.; McGlade, S.A.; Patterson, M.N.; Smith, T.J. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold

Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

Many genes and phenotypes have been mapped to the human X chromosome because of their characteristic sex-linked mode of inheritance in families. Thus, some 100 disease loci and at least 100 DNA markers have been localized to the human X chromosome in recent years. Until a few years ago, only two main linkage groups were established, one localized at Xpter and the other at Xqter. With the advent of DNA recombinant technology and the application of restriction-fragment-length polymorphisms (RFLPs) as genetic markers, it has been possible to construct a map spanning the entire human X chromosome. Markers are sufficiently well distributed along the chromosome to enable the mapping of almost any common sex-linked disorder. In particular, some of these have been used for the development of markers for the carrier detection and antenatal diagnosis of Duchenne muscular dystrophy and hemophilia A, and studies are under way to find closely linked markers for the fragile X syndrome. These linkage studies have provided the first step in the identification of the basic biochemical defects in several X-linked disorders. Various strategies are now being employed to proceed from these linked markers to the identification of the gene sequences involved in the development of the phenotype. 47 references, 3 figures, 2 tables.

39248 Analysis of an X-autosome translocation responsible for X-linked muscular dystrophy. Worton, R.G. (Univ. of Toronto (Canada)); Ray, P.N.; Bodrug, S.; Thompson, M.W. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

Duchenne muscular dystrophy (DMD) is an X-linked recessive disorder affecting approximately 1 in 3300 males, making it the most common of the neuromuscular dystrophies. Becker muscular dystrophy (BMD) is a similar disease, less frequent and less severe, but also X-linked. Evidence suggests that the genes responsible for the two disorders map close together on the X-chromosome short arm at band Xp21. Indeed, the two diseases may be caused by different mutations in the same gene locus. We have isolated by molecular cloning sequences from the junction of one of the X-autosome translocations. From this junction, we have walked along the X chromosome to isolate 60 kb of flanking sequence, have characteerized the translocation in detail, and have isolated DNA fragments revealing RFLPs that segregate in families with the DMD gene. Our results, are also consistent with a very large gene, or perhaps a set of related genes, at the DMD/BMD locus. 14 references, 4 figures, 1 table.

39249 Molecular genetics of Duchenne muscular dystrophy. Kunkel, L.M. (Children's Hospital, Boston, MA (USA)); Monaco, A.P.; Bertelson, C.J.; Colletti, C.A. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

The locus which is disrupted in patients with Duchenne Muscular Dystrophy (DMD) has been localized to the Xp21 region of the human X chromosome. Eight cloned fragments of DNA were isolated which were absent from the DNA isolated from a patient with a rare cytological deletion in Xp21 and three X-linked diseases, including DMD. With the assumption that a certain proportion of patients with solely the phenotype of DMD would be structural alterations at or nearby the locus responsible for the disease, the DNA isolated from patients was tested for deletion or rearrangement of one or more of the eight cloned fragments. One cloned segment, was found to be completely absent from the DNA isolated from 6.5% of patients with the phenotype of DMD. Over 230kb of DNA surrounding the original 200bp pERT87 cloned segment was obtained by 9 consecutive bidirectional chromosome walks. Six unique sequence subclones spaced over 120kb have been determined to identify 14 different restriction fragment length polymorphisms. The DNA samples isolated from 57 different patients who were shown to be deletions were sent to Boston and the extent of the deletions mapped within the 230kb of the DXS164 locus. Nearly one half of the deletions had at least one break within the DXS164 locus, the remainder were deleted for the entire 230kb of DNA. Three regions were indicated as potentially important by deletion breakpoint analysis and these have failed to identify a clear transcript when utilized as hybridization probes against Northern blots prepared from a variety of human RNA samples. Two of the three regions though are extensively conserved between different mammalian species. Both conserved regions have been narrowed to less than 500bp and the nucleotide sequence of each is currently being determined. The equivalent segments have been isolated from the mouse and each maps to the mouse X chromosome.

39250 Molecular genetics of Huntington's disease. Gusella, J.F. (Harvard Univ., Boston, MA (USA)); Gilliam, T.C.; Tanzi, R.E.; MacDonald, M.E.; Cheng, S.V.; Wallace, M.; Haines, J.; Conneally, P.M.; Wexler, N.S. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

Huntington's disease (HD) is an autosomal dominant neurodegenerative disorder characterized by premature localized nerve-cell death. In 1980, we set out to investigate HD using the increasing power of recombinant DNA technology. The straightforward approach applied to other genetic diseases of isolating a cDNA clone encoding the defective protein was not applicable, since no abnormal protein had been identified in HD. We chose to attack HD with a strategy that was independent of any assumptions concerning the nature of the gene defect. The clear-cut autosomal dominant mode of transmission and high penetrance of the disorder made it an ideal candidate for the application of genetic linkage analysis to discover the map location of the defect. In 1983, we discovered a polymorphic DNA marker genetically linked to HD and thereby assigned the defect to chromosome 4. The subsequent characterization of this marker has laid the groundwork for its use in presymptomatic detection and prenatal diagnosis of HD. It also set the stage for cloning the HD gene on the basis of its map position and elucidating the nature of this genetic defect. In this paper, we summarize current knowledge concerning the linked marker and chromosomal position of the HD gene. 23 references, 3 figures, 1 table.

39251 Molecular basis of phenylketonuria and potential somatic gene therapy. Woo, S.L.C. (Baylor College of Medicine, Houston, TX (USA)); DiLella, A.G.; Marvit, J.; Ledley, F.D. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

Classical phenylketonuria (PKU) is an autosomal recessive human genetic disorder caused by a deficiency in hepatic phenylalanine hydroxylase (PAH). We have recently reported the isolation of a full-length human PAH cDNA and have determined its sequence. Southern hybridization analysis of DNA isolated from PKU individuals demonstrated that the disorder is not caused by any obvious deletions, insertions, or rearrangements in the PAH gene. Using the full-length cDNA clone as the hybridization probe, a total of eight restriction-fragment-length polymorphisms in the human PAH locus are known. The polymorphism information content is such that almost 90% of PKU families are informative for analysis. To select appropriate mutant alleles for molecular analysis, we performed extensive RFLP haplotype analysis of the PAH locus. In PKU kindreds among Caucasians of Northern European ancestry, haplotype analysis showed that mutant alleles of four different RFLP haplotypes constitute 90% of PKU chromosomes in the population. In this paper, we discuss the molecular characterization of one of these mutant alleles and its tight association with a particular RFLP haplotype due to linkage disequilibrium, as well as potential therapy of PKU by somatic gene transfer. 24 references, 4 figures, 2 tables.

39252 Rate of sequence divergence estimated from restriction maps of mitochondrial DNAs from Papua New Guinea.

Stoneking, M. (Univ. of California, Berkeley (USA)); Bhatia, K.; Wilson, A.C. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

This paper presents a calibration of the rate of human mtDNA evolution based on mtDNA variation in Papua New Guinea, the first such estimate based entirely on within-species comparisons. Published data on mtDNA restriction site polymorphisms are available for 26 individuals, largely from the Eastern Highlands of Papua New Guinea. The present study adds 29 more individuals from coastal and island areas of New Guinea. Phylogenetic analysis of the mtDNAs allows us to estimate the rate of human mtDNA evolution by considering the average divergence from the common ancestor within each New Guinea-specific cluster of mtDNA types and by considering the average divergence between each New Guinea-specific cluster and the most closely related types outside New Guinea. We include estimates derived in a similar fashion for Australian mtDNA and American Indian mtDNA. These results all agree with the broadly defined rate of mtDNA evolution of 2-4% per million years, derived from comparisons of diverse vertebrate species. 32 references, 3 figures, 4 tables.

39253 Molecular genetic investigations of ancient human remains. Paabo, S. (Univ. of Uppsala (Sweden)). pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

Molecular evolution is a diachronic process of genetic change, taking place as a result of stochastic events, as well as natural selection. However, most of the evidence available for the study of molecular evolution is indirect and circumstantial, involving deduction from the distribution of polymorphism within and between modern species. A fundamentally new approach to evolutionary biology would be opened if it could be proved possible to investigate directly the fate of genes in a species or a population over substantial time periods. The present communication summarizes some preliminary attempts to achieve this by studying the preservation of DNA in ancient human remains. 35 references, 4 figures, 1 table.

39254 Abundant LINE-1 family of repeated DNA sequences in mammals: genes and pseudogenes. Skowronski, J. (National Institutes of Health, Bethesda, MD (USA)); Singer, M.F. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

We review the current status of the proposal that the L1 family includes functional genes. The interspecies homology between the coding regions of L1 elements in both nucleotide sequence and predicted amino acid sequence, and the ratio of silent to replacement-type mutations, are all similar to that seen in a variety of conserved genes. Similarly, the divergence between different species within the apparently noncoding 5' leader and 3' trailer regions is typical of many conserved genes. At least in the human teratocarcinoma cell line NTera2D1, polyadenylated, cytoplasmic RNAs that may prove to be functional mRNAs occur. These transcripts diverge less from one another than do the randomly selected genomic units. Thus, the evidence that selective pressure is operating to maintain the reading frames in humans is now substantial. 55 references, 4 figures, 2 tables.

39255 Primate α-globin gene family: a paradigm of the fluid genome. Marks, J. (Univ. of California, Davis (USA)); Shaw, J.P.; Perez-Stable, C.; Hu, W.S.; Ayres, T.M.; Shen, C.; Shen, C.K.J. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

The α-globins are an extraordinarily useful model for analyzing the dynamic processes that produced the human genome and that still occur within it. We approach problems of genomic turnover from a structural, biophysical, and cellular perspective. This work interfaces with systematics, primatology, and biological anthropology. The θ1 gene was discovered first in the orangutan because the human α-cluster had proven difficult to clone downstream from α1, and all the known globin proteins were accounted for genomically and there seemed no reason to expect anything of interest to exist there. By focusing our attention not only on genomic evolutionary processes, but on their evolutionary products in other closely related species as well, we have been able to frame and test hypotheses about the structure of the human genome, and reciprocally to make inferences about the processes themselves. 68 references, 7 figures.

39256 Molecular genetics of apolipoproteins and coronary heart disease. Deeb, S. (Univ. of Washington, Seattle (USA)); Failor, A.; Brown, B.G.; Brunzell, J.D.; Albers, J.J.; Motulsky, A.G. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

A variety of DNA markers for apolipoprotein genes were examined among patients with angiocardiographically proven heart disease and among a variety of normal individuals with various lipid values. An increased frequency of an apoAI-CIII SstI RFLP and an apoB minisatellite was found among patients with CHD. Higher levels of cholesterol were found among carriers of the rare apoB TaqI and the common apoCII TaqI variants, whereas higher levels of triglycerides were found in carriers of the common apoAII MspI and the rare apoB XbaI variants. Lower levels of HDL were found among carriers of the common apoAII MspI and the rare apoB PvuII variants. The biological significance of these results and those of other investigators for the pathogenesis of CHD and hyperlipidemia is suggestive but not yet fully clarified. 37 references, 2 figures, 4 tables.

39257 DNA markers and genetic variation in the human species. Cavalli-Sforza, L.L. (Stanford Univ. Medical Center, CA (USA)); Kidd, J.R.; Kidd, K.K.; Bucci, C.; Bowcock, A.M.; Hewlett, B.S.; Friedlaender, J.S. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

The differentiation of human ethnic groups is sufficiently recent that there has been no time for fixation of different alleles in different groups. The introduction of restriction enzyme analysis has enormously increased the number of polymorphisms that are available for study. Mitochondrial DNA has been analyzed by two groups. There are still very few data on polymorphisms for nuclear DNA in different ethnic groups, and available information will be presented. There is some discrepancy between results obtained with classical systems like blood groups, HLA, proteins and enzymes, mtDNA and nuclear DNA. The resolution of these discrepancies will most probably come from DNA segments that are not exposed to natural selection. In fact, parts of the genome exposed to natural selection may be more influenced by different environmental factors than by evolutionary history. 25 references, 1 figure, 7 tables.

39258 Hominoid evolution based on the structures of immunoglobulin epsilon and alpha genes. Ueda, S. (Univ. of Tokyo, (Japan)); Watanabe, Y.; Hayashida, H.; Miyata, T.; Matsuda, F.; Honjo, T. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

The human Ig Cε gene family consists of the Cε1 gene (active), the Cε2 gene (truncated pseudogene), and the Cε3 gene (processed pseudogene). Since mouse contains only one Cε gene, creation of two Cε pseudogenes in man seems to have taken place after mammalian radiation. Using the human Cε probe specific to

each family member, we have found that Old World monkeys have two Cε genes, the Cε1 and Cε3 genes. Among the hominoids only the gorilla and human contain the three Cε genes, whereas other hominoids have the Cε1 and Cε3 genes but not the Cε2 gene. The results indicate that either gorilla is more closely related to man than chimpanzee or that chimpanzee has lost the Cε2 gene after divergence of this species. To distinguish these possibilities we isolated DNA fragments containing the Cε1, Cε2, Cα1, and Cα2 genes from gorilla and chimpanzee DNAs. Characterization of these DNA segments by nucleotide sequence determination demonstrated that chimpanzee deleted the entire Cε2 gene. Comparison of nucleotide sequences of the Cε3 pseudogenes of man, gorilla, and chimpanzee allows different branching nodes of gorilla and chimpanzee from the human lineage. Such studies indicate that man is more closely related to chimpanzee than to gorilla. 22 references, 2 figures, 1 table.

39259 Cloning of cDNA and genomic DNA for human von Willebrand factor. Sadler, J.E. (Washington Univ., St. Louis, MO (USA)); Shelton-Inloes, B.B.; Sorace, J.M.; Titani, K. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

To better understand the complex biology and pathophysiology of von Willebrand factor (vWF), we have characterized cDNA and genomic DNA clones for this protein. This study along with others has finally laid to rest the historical notion that factor VIII and vWF might have a precursor-product relationship. These two hemostatic activities are present on two distinct proteins, each encoded by a separate gene. Whether there is coordinate regulation of the factor VIII and vWF genes is still unknown. These molecular biology and protein chemistry studies have shown that vWAgII is the amino-terminal propeptide of vWF, explaining the proportional deficiency of these two plasma proteins in von Willebrand disease (type I). In addition, sites of proteolytic processing, glycosylation, and disulfide bond formation have been defined, and some of the binding functions of mature vWF have been identified with specific amino acid sequences. The protein has a highly repeated structure, suggesting a complex evolutionary history. The A domains of vWF appear to be homologous to complement factor B, and perhaps to component C2. Genomic DNA clones have been isolated corresponding to approximately one third of the vWF gene on chromosome 12, and a fragment of the cDNA also hybridizes to uncharacterized sequences on chromosome 22. 50 references, 5 figures, 1 table.

39260 (GAO/RCED–88-27) **Biotechnology.** General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div. 1988. 108p. Available from US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877.

Genetic engineering using recombinant DNA allows the construction of organisms with new combinations of traits more precisely and rapidly than is possible by using traditional processes. Adverse consequences have occurred. Three federal agencies have dominated roles in regulating the use of genetically engineered organisms in the environment - the Department of Agriculture, the Environmental Protection Agency, and the Food and Drug Administration - but they have had limited experience with the issue and are uncertain about their effects. A variety of control methods are available to limit the genetically engineered micro-organisms' dispersal and impact. Choosing the appropriate degree of control involves a tradeoff between minimizing risk and maximizing the realism, and therefore the usefulness of the field test.

39261 (LBL–24018, pp. 16-19) **Molecular genetics of photosynthesis genes in rhodobacter capsulatus.** Hearst, J.E. Lawrence Berkeley Lab., CA (USA). Sep 1987. In *Chemical Biodynamics Division: Annual report, October 1, 1986-September 30, 1987.* Order Number DE88004886/JAW. Available from NTIS, PC A04/MF A01.

The R-prime plasmid, pRPS404, contains a 46kb segment of R. capsulatus DNA with coding information for photosynthetic proteins. It contains the tightly linked genes pufB, pufA, pufL, and pufM coding for the light-harvesting I β and α proteins and the L and M reaction center proteins, respectively. It also contains the unlinked gene puhA which codes for the reaction center H protein. Between the puf and puh loci is a long stretch of DNA with many genes for carotenoid and bacteriochlorophyll biosynthesis enzymes. The long term goal of this task is a complete understanding of this photosynthetic gene cluster, including a complete map of the genes contained on this piece of DNA, a complete nucleotide sequence of the entire gene cluster, an understanding of the enzymatic activity associated with each gene, and an understanding of the regulation of each of these genes especially with respect to light intensity and oxygen concentration.

5505 Metabolism

Refer also to citation(s) 37981, 38268, 39328

39262 (LBL–24018, pp. 35-37) **Biophysical chemistry.** Klein, M.P. Lawrence Berkeley Lab., CA (USA). Sep 1987. In *Chemical Biodynamics Division: Annual report, October 1, 1986-September 30, 1987.* Order Number DE88004886/JAW. Available from NTIS, PC A04/MF A01.

Phosphorus-31 NMR spectroscopy is evolving into an important means for determining the in vivo concentrations of phosphorylated metabolites and is now entering the clinical arena. Our previous contributions to this field demonstrated the feasibility of employing implanted radio frequency coils around organs of laboratory animals to permit eliciting the NMR spectra over long periods to establish normative spectra. Using these devices and techniques we have determined phosphorus exchange reactions in rat hearts and kidney, in situ, and have demonstrated that there are pools of metabolic intermediates that are not directly visible in the conventional high resolution NMR spectra. Comparison of the results from NMR spectroscopy with those obtained from radiolabeling studies on chick embryo fibroblasts also showed that there are significant pools of phosphorus not visible in the P-31 NMR spectrum. Both sets of studies suggest that compartmentation occurs. The invisibility of these pools is assumed to result from the immobilization of the molecules by cellular macromolecules or organelles.

5506 Medicine

Refer also to citation(s) 39182, 39189, 39191, 39192, 39195, 39196, 39199, 39245, 39246, 39247, 39249, 39250, 39299

39263 (BNL–42829) **Positioning error induced by axial sampling in positron emission tomography.** Bendriem, B.; Dewey, S.L.; Schlyer, D.J. Brookhaven National Lab., Upton, NY (USA). 1989. 9p. Sponsored by DOE Environment Health & Safety. DOE Contract AC02-76CH00016. (CONF-8904242–1: International congress on optical science and engineering, Paris, France, 24-28 Apr 1989). Order Number DE89014519/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A multi-slice Positron Camera organizes data as a set of parallel slices whose thickness is defined by the axial response function (ARF) of the tomograph. This ARF is usually not uniform and the sensitivity is maximum for a point source located at the center of the slice. As a consequence, the partial volume effect (quantitation loss for structures that are smaller than two to three times the FWHM resolution) will be dependent not only on the size of the structure but also on its relative position with regard to the ARF. We have developed a computer simulation to analyze this effect. Objects of different size and shape are examined and it is shown that on a system with a 6 mm axial resolution (FWHM), a shift of 3 mm can introduce more than 10% variation on the final measurement. The simulation is confirmed by experimental results on a high resolution PET. We conclude that positioning and repositioning must be handled with great care in order to make reproducible measurements and allow accurate partial volume corrections. 7 refs., 3 figs., 5 tabs.

39264 Carrier detection and gene analysis of Duchenne muscular dystrophy. Pearson, P.L. (Sylvius Laboratories, Leiden (Netherlands)); van Ommen, G.J.B.; Bakker, E. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium

on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

We conclude that the genetic region involved with the Duchenne muscular dystrophy locus is extremely large. It is likely that part of the predisposition to high mutation at the DMD locus is a reflection of the large target size. Many aspects of the problem remain unresolved and further in-depth studies will be required to determine why meiotic recombination apparently occurs at such a high frequency. The ultimate goal will be structure and regulation studies of the gene or gene cluster itself, which, considering the complexities already encountered, is likely to be a mammoth task requiring the involvement of many research groups. However, the stakes in terms of human suffering are high, and neither the scientific nor the funding communities should shirk their responsibilities. 20 references, 4 figures.

39265 Cloned factor VIII and the molecular genetics of hemophilia. Lawn, R.M. (Genentech, Inc., San Francisco, CA (USA)); Wood, W.I.; Gitschier, J.; Wion, K.L.; Eaton, W.D.; Vehar, G.A.; Tuddenham, E.G.D. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

In the past 5 years, there has been an enormous increase in the understanding of factor VIII and hemophilia. The cloning of the human factor VIII gene and subsequent studies have provided a clearer picture of the protein and its processing. Further studies, aided by the recombinant DNA-driven expression of altered factor VIII molecules, will be needed to define its mode of action precisely. Cloned DNA probes have revealed the molecular basis of some cases of hemophilia, have clarified the uncertainty about the site of factor VIII synthesis, and have provided DNA-based carrier detection and prenatal diagnosis of hemophilia A. 18 references, 3 figures.

39266 Comparison of deficiency alleles of the β-globin and factor VIII:C genes: new lessons from a giant gene. Kazazian, H.H. Jr. (Johns Hopkins Hospital, Baltimore, MD (USA)); Antonarakis, S.E.; Youssoufian, H.; Dowling, C.E.; Phillips, D.G.; Wong, C.; Boehm, C.D. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

Certain variables strongly influence the type of deficiency alleles observed at a locus, e.g., the size of the relevant gene, its chromosomal location, and whether deficiency alleles are under the influence of positive selection. In the case of the β-globin locus, the gene is small, the locus is autosomal in location, and β-thalassemia alleles are under positive selection. In contrast, the factor VIII:C gene is quite large, and, because deficiency alleles are essentially X-linked lethals, the mutations have a life of two to four generations in a stationary population and nearly all deficiency alleles are observed. Moreover, deficiency alleles are not under positive selection and are observed at the same frequency in all ethnic groups. Thus, the frequency of the various types of mutant alleles observed should be relatively unbiased for this locus or any large, X-linked locus at which deficiency alleles are genetic lethals. 29 references, 5 figures, 1 table.

39267 Characterization studies of human tissue-type plasminogen activator produced by recombinant DNA technology. Vehar, G.A. (Genentech, Inc., San Francisco, CA (USA)); Spellman, M.W.; Keyt, B.A.; Ferguson, C.K.; Keck, R.G.; Chloupek, R.C.; Harris, R.; Bennett, W.F.; Builder, S.E.; Hancock, W.S. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

The ability to safely increase the rate of lysis of unwanted blood clots in vasculature has been a goal of clinical medicine for many years. Current therapeutics have unwanted side effects that complicate safe and effective therapy. For these reasons, a more effective and safe fibrinolytic agent is required. The ideal activator of plasminogen would selectively activate plasminogen in the vicinity of a clot while effecting minimal systemic activation. Tissue plasminogen factor (t-PA) possesses these properties. This plasminogen activator specifically binds fibrin, and its ability to activate plasminogen is markedly increased in the presence of fibrin. These two properties would be expected to give t-PA the specificity required of an effective and specific fibrinolytic agent. Preliminary studies on t-PA produced by a melanoma cell line were promising. To make a sufficient t-PA at a cost-effective price recombinant DNA techniques were employed to express the protein in bacteria. We present here a report on work directed toward the production and characterization of recombinant tissue plasminogen activator (rt-PA) expressed in CHO cells, and some of the physical properties of the resulting protein. 70 references, 7 figures, 3 tables.

39268 Interferon production from human cell cultures. Finter, N.B. (Wellcome Biotech, Kent (England)); Ball, G.D.; Fantes, K.H.; Johnson, M.D.; Lewis, W.G. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

Human proteins required for medical purposes, e.g., insulin, interferons, tissue plasminogen activator, and growth hormone, can now often be produced by recombinant DNA procedures. They can also be obtained by extraction from the appropriate human organ or by stimulating human cells grown in culture to make the protein of interest. We pioneered production by the latter approach in order to make enough human interferon for large-scale clinical trials; we continue to use this route today, because we think it has certain advantages. To understand our reasons, some points from the history of interferons must be considered. 18 references, 2 figures.

39269 (CONF-8806231–2) **[Atomic and molecular data for radiotherapy]: Introductory remarks.** Inokuti, Mitio. Argonne National Lab., IL (USA). 1988. 7p. Sponsored by DOE Environment Health & Safety. DOE Contract W-31109-ENG-38. From International Atomic Energy Agency (IAEA) advisory group meeting on atomic and molecular data for radiotherapy; Vienna, Austria; 13-16 Jun 1988. Order Number DE89013647/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The purpose of this report is to survey the current status of atomic and molecular data needed in radiation research and therapy and to identify areas appropriate for research in the near future. Although the relevance of atomic and molecular data to radiation interactions with matter is widely understood in general terms, it is appropriate at the outset to consider different needs for atomic and molecular data that depend upon specific purposes. 3 refs.

39270 (DOE/ER/60519–4) **New imaging systems in nuclear medicine.** Massachusetts General Hospital, Boston, MA (USA). Physics Research Lab. [1989]. 48p. Sponsored by DOE Energy Research. DOE Contract FG02-87ER60519. Order Number DE89015459/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

PCR-I, an analog coded single ring positron tomograph, demonstrates the concepts of analog coding and the utility of high resolution systems. PCR-I, with a resolution of 4.5mm, has been employed in a series of biological studies using small animals that have been highly successful and will lead to clinical application. The emphasis now is turning to even higher sensitivity instruments in order to provide adequate number of events to populate a volume image. For this purpose, we have designed and are constructing PCR-II, a cylindrical analog coded positron tomograph incorporating 12,800 small detectors coded to 1760 phototubes. The increased sensitivity is achieved by recording all events within a cylindrical source that produce annihilation radiation striking any point on the cylindrical detector. PCR-II is projected to have a sensitivity of 1.6 million counts per second for a 20 centimeter diameter sphere uniformly filled with activity at 1 $\mu Ci/cm^3$. This system, with a resolution of 3mm, will approach the limits of sensitivity and resolution for positron tomographs. It is our opinion that this system will revolutionize the concept of positron imaging.

39271 (INIS-mf–11396, pp. 94) **Characterisation of the NAC neutron therapy beam.** Jones, D.T.L. (Atomic Energy Corp. of South Africa (Pty) Ltd., Pretoria (South Africa)); Hendrikse, W.L.J.; Yudelev, M. South African Inst. of Physics, Faure (South Africa). 1987. (CONF-8707216–: 32. Annual conference of the South African Institute of Physics, Durban, South Africa, 13-17 Jul 1987). In *32nd Annual conference and the 22nd annual theoretical seminar of the South African Institute of Physics.* Order Number DE89615754/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

This publication contains only the abstracts of seminars.

NEUTRON THERAPY/neutron beams; ACCELERATORS; OPERATION

39272 (INIS-mf–11448, pp. 15) **Neutron capture therapy.** Allen, B.J. (Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia)). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1987. (CONF-8708339–: 11. AINSE radiation biology conference, Lucas Heights, Australia, 24-25 Aug 1987). In *Conference handbook.* Order Number DE89616297/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

NEUTRON CAPTURE THERAPY; AUSTRALIA; NEOPLASMS; RESEARCH PROGRAMS

39273 (LA-UR–89-1579) **Monte Carlo analysis of localization errors in magnetoencephalography.** Medvick, P.A.; Lewis, P.S.; Aine, C.; Flynn, E.R. Los Alamos National Lab., NM (USA). 1989. 5p. Sponsored by DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-890849–2: 7. international conference on biomagnetism, New York, NY, USA, 14-18 Aug 1989). Order Number DE89013221/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In magnetoencephalography (MEG), the magnetic fields created by electrical activity in the brain are measured on the surface of the skull. To determine the location of the activity, the measured field is fit to an assumed source generator model, such as a current dipole, by minimizing chi-square. For current dipoles and other nonlinear source models, the fit is performed by an iterative least squares procedure such as the Levenberg-Marquardt algorithm. Once the fit has been computed, analysis of the resulting value of chi-square can determine whether the assumed source model is adequate to account for the measurements. If the source model is adequate, then the effect of measurement error on the fitted model parameters must be analyzed. Although these kinds of simulation studies can provide a rough idea of the effect that measurement error can be expected to have on source localization, they cannot provide detailed enough information to determine the effects that the errors in a particular measurement situation will produce. In this work, we introduce and describe the use of Monte Carlo-based techniques to analyze model fitting errors for real data. Given the details of the measurement setup and a statistical description of the measurement errors, these techniques determine the effects the errors have on the fitted model parameters. The effects can then be summarized in various ways such as parameter variances/covariances or multidimensional confidence regions. 8 refs., 3 figs.

39274 (LBL–25451) **Maximum entropy and the concept of feasibility in tomographic image reconstruction.** Nunez, J.; Llacer, J. Lawrence Berkeley Lab., CA (USA). Jan 1989. 14p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890115–2: 3. conference on medical imaging, Newport Beach, CA, USA, 29 Jan - 3 feb 1989). Order Number DE89014886/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Feasible images in tomographic image reconstruction are defined as those images compatible with the data by consideration of the statistical process that governs the physics of the problem. The first part of this paper reviews the concept of image feasibility, discusses its theoretical problems and practical advantages, and presents an assumption justifying the method and some preliminary results supporting it. In the second part of the paper two different algorithms for tomographic image reconstruction are developed. The first is a Maximum Entropy algorithm and the second is a full Bayesian algorithm. Both algorithms are tested for feasibility of the resulting images, and we show that the Bayesian method yields feasible reconstructions in Positron Emission Tomography. 25 refs., 3 figs.

5507 Microbiology

Refer also to citation(s) 37981, 39125

5508 Morphology

Refer also to citation(s) 39196, 39198, 39200, 39242

5509 Pathology

Refer also to citation(s) 39193, 39194, 39245, 39251, 39256

5510 Physiological Systems

Refer also to citation(s) 39201

39275 (LA-UR–89-1729) **Transient visual evoked neuromagnetic responses: identification of multiple sources.** Aine, C.; George, J.; Medvick, P.; Flynn, E.; Bodis-Wollner, I.; Supek, S. Los Alamos National Lab., NM (USA). 1989. 5p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890849–1: 7. international conference on biomagnetism, New York, NY, USA, 14-18 Aug 1989). Order Number DE89013438/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Neuromagnetic measurements and associated modeling procedures must be able to resolve multiple sources in order to localize and accurately characterize the generators of visual evoked neuromagnetic activity. Workers have identified at least 11 areas in the macaque, throughout occipital, parietal, and temporal cortex, which are primarily or entirely visual in function. The surface area of the human occipital lobe is estimated to be 150–250cm. Primary visual cortex covers approximately 26cm^2 while secondary visual areas comprise the remaining area. For evoked response amplitudes typical of human MEG data, one report estimates that a two-dipole field may be statistically distinguishable from that of a single dipole when the separation is greater than 1–2 cm. Given the estimated expanse of cortex devoted to visual processes, along with this estimate of resolution limits it is likely that MEG can resolve sources associated with activity in multiple visual areas. Researchers have noted evidence for the existence of multiple sources when presenting visual stimuli in a half field; however, they did not attempt to localize them. We have examined numerous human MEG field patterns resulting from different visual field placements of a small sinusoidal grating which suggest the existence of multiple sources. The analyses we have utilized for resolving multiple sources in these studies differ depending on whether there was evidence of (1) synchronous activation of two spatially discrete sources or (2) two discrete asynchronous sources. In some cases we have observed field patterns which appear to be adequately explained by a single source changing its orientation and location across time. 4 refs., 2 figs.

5520 Public Health

39276 Population genetics of α-thalassemia and the malaria hypothesis. Hill, A.V.S. (Univ. of Oxford (England)). pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; Cold Spring Harbor, NY, USA; 28 May - 4 jun 1986.

In this study comparison of the $\alpha\pm$thalassemia frequencies of individuals from different parts of Melanesia with historical preintervention endemicities of malaria showed a strong correlation, whether the latter varied with latitude or altitude. DNA analysis of other unlinked polymorphisms failed to show significant population differences for these markers. Moreover, subtyping and restriction enzyme haplotype analysis of -α chromosomes from Melanesians argue for multiple local origins for these deletions. It is proposed that these data strongly support the hypothesis of selection by malaria. 45 references, 3 figures, 5 tables.

39277 (PB–89-168132/XAB) **Hazard Communication Project: computer-based training course (for microcomputers). Software.** Fisher, S. Office of Personnel Management, Washington, DC (USA). Mar 1989. vp. Available from NTISCP D02.

The software is contained on 5 1/4-inch diskettes, double density (360K), compatible with the IBM PC microcomputer. The diskettes are in the ASCII format. Price includes documentation, PB–89-168140.

The software is computer-based training with the following course objectives: to inform employees of their employer's requirements under the OSHA Hazard Communication Standard (29 CFR 1910.1200); to instruct employees on the procedures for obtaining and using information on hazardous materials, including understanding labeling systems and understanding the material safety data sheet (MSDS) information; to provide information on 11 classes of chemicals, including their common uses, potential physical and health hazards, detection methods, and safety measures to follow. There are 14 lessons, ranging in length from 30 minutes to 1 (one) hour. Software Description: The software is written in the UNISON language for use on an IBM PC or compatible machines using MS DOS operating system. It requires 378K of memory. Special requirements are an EGA graphics card and monitor. The program will not run on monochrome or CGA systems.

5530 Agriculture and Food Technology

Refer also to citation(s) 39217, 39292

39278 (CNEA–487) **Ionizing radiation control of Tribolium castaneum in wheat flour type 000.** Informe. Ritacco, M. Comision Nacional de Energia Atomica, Buenos Aires (Argentina). 1988. 12p. (In Spanish). Order Number DE89631259/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Informe.

The insects, mainly those of the coleoptera order, produce serious changes on the grains and flours, producing in some regions up to 50 % loss. Taking in account the information available up to date, this experiment consists of putting under the effect of the ionizing radiation specimens of Tribolium castaneum feeded with bread flour type 000, with the purpose of controling their biological cycle. They received gamma radiation doses between 250 and 2000 Gy, using ^{60}Co source. The daily observation made over a population of 590 insects, indicates the efficiency of the procedure, non toxic, which provokes the sterility at 250 Gy and inmediate dead starting at 1750 Gy. On the other hand, it was verified that the DL_{50} on the insects irradiated at the lower of eight different doses applied, reaches 15,3 days, against the 162,6 days of the reference Tribolium. Then it is concluded that it is technologically feasible the application of ionizing radiation to the bread wheat flour type 000 for controling this main plage.

39279 (CNEA–488) **Study about the use of ionizing radiation to delay the putrefaction of strawberries 'Tioga'.** Informe. Ritacco, M. Comision Nacional de Energia Atomica, Buenos Aires (Argentina). 1988. 25p. (In Spanish). Order Number DE89631260/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Informe.

The influence of the ionizing radiation has been studied in fresh strawberries of the variety 'Tioga', with the purpose to extend its commercialization period. After the packaging in semi-permeable polyethylene, the material was procesed using ^{60}Co source of 400kCi. The strawberries were irradiated with a dose of 2kGy. The treated products and the unirradiated ones were stored refrigerated at 5 deg C with a relative humidity of 90 % and in absence of light. Each 4 days, chemical, organoleptics and microbiological studies were carried out and conditions of expense and transport post-irradiation were simulated. The results obtained would indicate the technological viability of ionizing radiations on this type of berries, keeping them in a good state during a period of 28 days post-treatment, the unirradiated material showed undiserable microbiological, organoleptics and chemical alterations after the 4th day of storage. (Autor).

39280 (CNEA–489) **Gamma-radiation control of the Sitophilus-orizae insect pest in the wheat grain storage.** Informe. Ritacco, M. Comision Nacional de Energia Atomica, Buenos Aires (Argentina). 1988. 9p. (In Spanish). Order Number DE89631261/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Informe.

Insects produce very important grain lost in the cereal storage. This lost is highly variable according to the type of cereal and the stored time. The principal pest among coleopters is Sitophilus orizae which attacks wheat grains. Ionizing radiation allowed us to develope an alternative control method to the chemical insecticides which have serious disadvantages. Our results expressed as the DL_{50}, showed a considerable reduction of adult life spanning from 250 Gy. Post-irradiation adquired sterility was observed in the stored grain due to the absence of descendents. (Autor).

39281 (IAEA-TECDOC–490) **Safety factors influencing the acceptance of food irradiation technology. Report of a task force meeting on public information of food irradiation convened by the International Consultative Group on Food Irradiation and held in Cadarache, France, 18-21 April 1988.** International Atomic Energy Agency, Vienna (Austria). Jan 1989. 106p. (CONF-8804282–: Task force meeting on public information of food irradiation, Cadarache, France, 18-21 Apr 1988). Order Number DE89619871/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

The International Consultative Group on Food Irradiation convened a Task Force Meeting on Public Information of Food Irradiation at the French Commissariat a l'Energie Atomique (CEA), Cadarache from 18 to 21 April 1988. A compilation of scientific papers on subjects of public interest on food irradiation was made by internationally-recognized experts. The report of the meeting and the review papers presented at the meeting are included in this publication. Refs, figs and tabs.

39282 (INIS-mf–11440, pp. 588-589) **Determination of I-131, Cs-134, Cs-137 in plants and cheese after Chernobyl accident in Romania.** Constantinescu, B. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering); Galeriu, D.; Ivanov, E.; Pascovici, G.; Plostinaru, D. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Various samples from the SE region of Romania were analyzed for I-131, Cs-134 and Cs-137 concentration during May-July 1986 by gamma spectrometry. (authors).

39283 (INIS-mf–11440, pp. 586-587) **Considerations about I-131, Cs-134 and Cs-137 concentrations in 1986 for some Romanian food-stuff.** Constantinescu, B. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering); Galeriu, D.; Ivanov, E.; Pascovici, G.; Plostinaru, D. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Some results from after Chernobyl nuclear accident measurements on originating in SE area of Romania food-stuff samples are presented. (authors).

39284 (INIS-mf–11440, pp. 661) **Cesium-137 and cesium-134 measuring in animal origin samples using a NaI(Tl) scintillation detector device.** Stere, G. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering); Popa, L. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

A non-computer stripping method is applicable to determinate the amount of 137Cs in meat. (authors).

39285 (INIS-mf–11440, pp. 659-660) **Estimation of the dose equivalent and the body amount after ingestion of radiocesium contaminated food.** Stere, G. (Central Inst. of Physics, Bucharest

(Romania). Inst. of Physics and Nuclear Engineering). Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics*. Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

A model for estimate by rapid way the dose and the body amount of radioactivity due to ingested 137Cs and 134Cs.

39286 (INIS-mf–11448, pp. 9R) **Status of current research activities in food irradiation.** Wills, P.A. (Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia)). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1987. (CONF-8708339–: 11. AINSE radiation biology conference, Lucas Heights, Australia, 24-25 Aug 1987). In *Conference handbook*. Order Number DE89616297/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

FOOD/irradiation; AUSTRALIA; FOOD; IRRADIATION; RESEARCH PROGRAMS

39287 (INIS-mf–11448, pp. 14) **Food irradiation - the consumer perspective.** Heilpern, S. (Australian Consumers' Association, Sydney (Australia)). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1987. (CONF-8708339–: 11. AINSE radiation biology conference, Lucas Heights, Australia, 24-25 Aug 1987). In *Conference handbook*. Order Number DE89616297/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

FOOD/irradiation; AUSTRALIA; FOOD; IRRADIATION; GOVERNMENT POLICIES; PUBLIC OPINION; RECOMMENDATIONS; TOXICITY

39288 (INIS-mf–11448, pp. 13) **Ionising radiation.** Lavin, M.F. (Queensland Univ., St. Lucia (Australia). Dept. of Biochemistry). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1987. (CONF-8708339–: 11. AINSE radiation biology conference, Lucas Heights, Australia, 24-25 Aug 1987). In *Conference handbook*. Order Number DE89616297/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

FOOD/radiolysis; DNA; FOOD; RADIOLYSIS; HYDROXYL RADICALS; IRRADIATION; NUCLEOTIDES

39289 (INIS-mf–11448, pp. 12) **Radiation chemistry's contribution to the food irradiation debate.** Laurence, G.S. (Adelaide Univ. (Australia). Dept. of Physical and Inorganic Chemistry). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1987. (CONF-8708339–: 11. AINSE radiation biology conference, Lucas Heights, Australia, 24-25 Aug 1987). In *Conference handbook*. Order Number DE89616297/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

FOOD/chemical radiation effects; FOOD; IRRADIATION; RADIATION CHEMISTRY; RADIOLYSIS

39290 (INIS-mf–11448, pp. 16) **Prospects for food irradiation in New Zealand.** Roberts, P.B. (Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Inst. of Nuclear Sciences). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1987. (CONF-8708339–: 11. AINSE radiation biology conference, Lucas Heights, Australia, 24-25 Aug 1987). In *Conference handbook*. Order Number DE89616297/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

FOOD/irradiation; FOOD; IRRADIATION; GOVERNMENT POLICIES; IRRADIATION PLANTS; NEW ZEALAND; REGULATIONS

39291 (INIS-mf–11459, pp. 34) **Radioactive analysis on contaminated food.** Zuniga, P. (Instituto Peruano de Energia Nuclear, Lima (Peru)); Regalado, S. Sociedad Quimica del Peru, Lima (Peru). Oct 1987. (In Spanish). (CONF-8710479–: 15. Peruvian Congress of Chemistry, Lima (Peru), 12-17 Oct 1987). In *Resumenes de los trabajos*. Order Number DE89012192/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

FOOD/contamination; CHERNOBYLSK-4 REACTOR; FOOD; CONTAMINATION; GAMMA SPECTROSCOPY

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

Refer also to citation(s) 38207, 38491, 39213, 39244, 39570, 39576

39292 (BALUF-STS–87-03) **Determination of transfer factors and effective half-times in several domestic animals for cesium 137 from the Chernobyl reactor accident. Part 1: several problems.** Henrich, E.; Schoener, W. Bundesanstalt fuer Lebensmitteluntersuchung und -forschung, Vienna (Austria). 1987. 42p. (In German). Order Number DE89631205/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

In the wake of the Chernobyl accident contaminated fodder-hey and grass has been fed to cows, bulls, calves, lambs and swine (fed with whey). The problem was to decide if or not the animals could be slaughtered with confidence that their meat had contaminations below the legal limits. On the one hand, transfer factors fodder-to-meat and fodder-to-milk as well as the efficiency of radioactivity reducing additives had to be determined. On the other hand the correlation of live-animals measurements with the meat contamination was investigated. The correlation was satisfactory except with swine. The high-resolution Ge detectors have strong advantages as compared to Na detectors, though too expensive for general applications in slaughter-houses. 10 refs., 14 figs., 12 tabs. (qui).

39293 (CEA-R–5476) **Experimental Data related to physico-chemical forms of antinomy 125 and silver 110m and to their transfers to a freshwater fish, the carp.** Baudin, J.P.; Garnier, J.; Lambrechts, A.; Foulquier, L. CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Mar 1989. 77p. (In French). Order Number DE89791921/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The ^{125}Sb remains dissolved in the water but may be partly adsorbed on the sediment. No particulate and colloidal forms appear in the water, even in the presence of living organisms. The major part of the dissolved ^{125}Sb is fixed by anionic resin. ^{125}Sb accumulation by carp from water is a very weak phenomenon which results in a concentration factor of approximately 0.15. The best part of the ^{110m}Ag brought in the water is rapidly adsorbed on all available surfaces and colloidal and particulate forms develop in the medium. The real dissolved forms represent less than 50 % of the water radioactivity and are essentially retained by anionic resin. The bioaccumulation, from water, of the ^{110m}Ag by the carp results in a maximal concentration factor of about 140. The accumulation from food shows that trophic pathway may be as important as direct pathway in the transfer to fish.

39294 (CEA-R–5479) **Acute irradiation and muscular fibrosis. Development and characteristics in the pig.** Lefaix, J.L.; Daburon, F.; Remy, J. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection Sanitaire. 1989. 84p. (In French). Order Number DE89791923/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

This study was performed in an experimental porcin model of acute local irradiation chosen to simulate human accidents. It enabled to determine the development and the physiopathological characteristics of the fibrous tissue which developed in skeletal muscle. In the first month after irradiation the strong inflammatory reaction initiating the radiation induced fibrosis was characterized by edema as visualized on NMR imaging and by acute phase reactant protein changes, associated with elevations of local and general temperatures in irradiated animals. At the margin of the irradiated tissue, atypical fibroblasts isolated among collagen bundles or bunched in nodullary reinforcement were seen associated with intense capillary neogenesis. Several months after irradiation normal skeletal muscle was replaced by atrophic fibrosis delimited by an inflammatory perifibrotic tissue. The muscular fibrosis was characterized by a high atypical fibroblasts density and by an inflammatory distribution pattern of collagen types I, III, IV, laminin, fibronectin and fibrinogen as visualized by immunohistochemical methods. Biochemical results showed an increase in collagen content and synthesis in fibrotic tissue whereas perifibrotic zone synthesized more non collagenous proteins compared with the normal muscle.

The contributions of granulation tissue, cellular mediators and inhibition of muscular regeneration to maintain the atrophic character of the muscular radiation induced fibrosis are discussed.

39295 (GR-A–88-05) **Ionizing radiation. From effects to protection.** Passchier, W.F. (Gezondheidsraad, The Hague (Netherlands)) (ed.). Gezondheidsraad, The Hague (Netherlands). 1 Aug 1988. 105p. (In Dutch). Available from library KNAW, P.O. Box 41950, 1009 DD Amsterdam, Netherlands.

This report is part two from the series 'Future explorations' of the Dutch Counsil for Public Health. It contains contributions on biological effects of radiation in which information is presented on research into the occurrence of cancer in patients treated with radiotherapy and irradiated laboratory animals, on the effects of prenatal irradiation, and on the possibile, only in laboratory-animal research demonstrated, effects of irradiation in offspring of irradiated parents. In other contributions, which put the 'link' between the radiology and the practical radiation hygienics, it appears that the increased scientific knowledge does not make it easier to design radiation-hygienic standards and rules. (H.W.). refs.; figs.; tabs.

39296 (GR-A–88-05, pp. 69-88) **Occurrence in tumours in laboratory animals after exposure to ionizing radiation.** Broerse, J.J. (Gezondheidsraad, The Hague (Netherlands)). Gezondheidsraad, The Hague (Netherlands). 1 Aug 1988. (In Dutch). In *Ionizing radiation. From effects to protection.* Available from library KNAW, P.O. Box 41950, 1009 DD Amsterdam, Netherlands.

In this article some of the radiobiological studies with laboratory animals are described which have been performed in the Dutch Radiobiological Institute TNO. These studies found their origin in questions with regard to the public health. It is concluded that the risk factors for the origin of tumours in man caused by exposure of ionizing radiation, which are generally accepted, is confirmed by these studies. (H.W.). 21 refs.; 7 figs.; 2 tabs.

39297 (GR-A–88-05, pp. 41-52) **Effects of prenatal irradiation.** Vos, O. (Erasmus Univ., Rotterdam (Netherlands). Afd. Celbiologie en Genetica). Gezondheidsraad, The Hague (Netherlands). 1 Aug 1988. (In Dutch). In *Ionizing radiation. From effects to protection.* Available from library KNAW, P.O. Box 41950, 1009 DD Amsterdam, Netherlands.

In this article a survey is presented of the actual knowledge about the effects of irradiation of embryos and fetuses.; figs.; tabs. (H.W.). 15 refs.

39298 (GR-A–88-05, pp. 53-68) **Genetic effects of exposure to ionizing radiation.** Tates, A.D. (Rijksuniversiteit Leiden (Netherlands). Lab. voor Stralengenetica en Chemische Mutagenese). Gezondheidsraad, The Hague (Netherlands). 1 Aug 1988. (In Dutch). In *Ionizing radiation. From effects to protection.* Available from library KNAW, P.O. Box 41950, 1009 DD Amsterdam, Netherlands.

This article discuss the occurrence of mutations in germ cells by ionizing radiation. (H.W.). 11 refs.; 2 tabs.

39299 (GR-A–88-05, pp. 89-105) **Risk for new tumours after treatment of breast cancer of women.** Boice, J.D. (National Cancer Inst., Bethesda (USA). Radiation Epidemiology Branch). Gezondheidsraad, The Hague (Netherlands). 1 Aug 1988. (In Dutch). In *Ionizing radiation. From effects to protection.* Available from library KNAW, P.O. Box 41950, 1009 DD Amsterdam, Netherlands.

In this article the chance for a new tumour after a succesful treatment of breast cancer is worked out. The chance of a second tumour for treated women turns out to be three times as large as the change which an arbitrary group of contemporaries has of cancer. These (second) tumours mostly occur in the other breast. It is not quite clear in how far treatment with ionizing radiation can influence the origin of new tumours. The chance for re-occurring of breast cancer appears to be somewhat higher for women who underwent radiotherapy than for woman who were treated otherwise. Also leukemia occurred more often in women treated with than without ionnizing radiation; however, absolutely seen it does concern very small numbers. The importance of a good registration of cancer and the way of treatment of cancer are illustrated. Epidemiologic research as described may contribute in finding the most effective treatment with the least side effects. (H.W.). 15 refs.; 3 figs.; 3 tabs.

39300 (GR-A–88-05, pp. 27-40) **Casualties and threshold effects. Does the classification of radiation effects have to be revised?.** Mays, C.W. (National Council on Radiation Protection and Measurements, Bethesda, MD (USA)). Gezondheidsraad, The Hague (Netherlands). 1 Aug 1988. (In Dutch). In *Ionizing radiation. From effects to protection.* Available from library KNAW, P.O. Box 41950, 1009 DD Amsterdam, Netherlands.

Radiation effects like cancer are denoted as casualties. Other radiation effects occur almost in everyone when the radiation dose is sufficiently high. One then speaks of radiation effects with a threshold dose. In this article the author puts his doubt about this classification of radiation effects. He argues that some effects of exposure to radiation do not fit in this classification. (H.W.). 19 refs.; 2 figs.; 1 tab.

39301 (INIS-mf–11440, pp. 577) **Contamination with cesium of some wild plants after 1986 nuclear accident.** Chereji, I. (Institutul de Tehnologie Izotopica si Moleculara, Cluj-Napoca (Romania)); Bogdan, D.; Bratu, C.; Daraban, L.; Boscaneanu, S. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The Cs radioactivity of some wild plants harvested in different parts of Transylvania is followed in two or three succesive vegetation years. (authors).

39302 (INIS-mf–11440, pp. 584-585) **Study concerning Cs-137 elimination in urine 1 year after 26.04.1986.** Chiosila, I. (Spitalul Fundeni, Bucharest (Romania)); Chirovici, M.; Reviu, E. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

An evaluation of Cs-137 elimination in urine is presented. (authors).

39303 (INIS-mf–11440, pp. 582-583) **Experimental study concerning reduction of I-31 fixation in thyroid by means of $KClO_4$.** Chiosila, I. (Spitalul Fundeni, Bucharest (Romania)); Jiquidi, L.; Chirovici, M.; Reviu, E.; Paun, C.; Safta, T. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The reduction effect of I-131 fixation in rats and dogs with the help of $KClO_4$ at various periods of time after contamination. (authors).

39304 (INIS-mf–11448, pp. 7) **Mutagenesis in procaryotes - recent developments.** MacPhee, D.G. (La Trobe Univ., Bundoora (Australia). Dept. of Microbiology). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1987. (CONF-8708339–: 11. AINSE radiation biology conference, Lucas Heights, Australia, 24-25 Aug 1987). In *Conference handbook.* Order Number DE89616297/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

MUTAGENESIS/dna; DNA POLYMERASES; MUTAGENESIS; DNA; MUTAGENS; MUTATIONS; RADIATION DOSES

39305 (INIS-mf–11448, pp. 8) **Effects of mutagenic and antimutagenic treatments on precise excision of Tn10.** Hafner, L.M. (La Trobe Univ., Bundoora (Australia) Dept. of Microbiology); MacPhee, D.G. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1987. (CONF-8708339–: 11. AINSE radiation biology conference, Lucas Heights, Australia, 24-25 Aug 1987). In *Conference handbook.* Order Number DE89616297/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

DNA REPAIR/salmonella typhimurium; GENES; MUTAGENESIS; MUTAGENS; ULTRAVIOLET RADIATION

39306 (INIS-mf–11448, pp. 9) **Frameshift mutagenesis by chloroquin in Salmonella typhimurium and Escherichia coli.**

MacPhee, D.G. (La Trobe Univ., Bundoora (Australia). Dept. of Microbiology); Silburn, K.A. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1987. (CONF-8708339–: 11. AINSE radiation biology conference, Lucas Heights, Australia, 24-25 Aug 1987). In *Conference handbook.* Order Number DE89616297/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

MUTAGENESIS/salmonella typhimurium; ESCHERICHIA COLI; MUTAGENESIS; MUTAGENS

39307 (INIS-mf–11448, pp. 10) **Co-mutagenicity of commonly-used laboratory glassware.** Podger, D.M. (CSIRO Division of Molecular Biology, North Ryde (Australia)). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1987. (CONF-8708339–: 11. AINSE radiation biology conference, Lucas Heights, Australia, 24-25 Aug 1987). In *Conference handbook.* Order Number DE89616297/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

MUTAGENESIS/glass; ACRIDINES; MUTAGENESIS; GLASS; MUTAGENS; MUTATIONS; POLYPROPYLENE; SALMONELLA TYPHIMURIUM

39308 (INIS-mf–11448, pp. 11) **DNA damage by Auger electrons.** Martin, R.F. (Peter MacCallum Cancer Institute, Melbourne (Australia)); D'Cunha, G.; Pardee, M.; Murray, V.; Allen, B.J. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1987. (CONF-8708339–: 11. AINSE radiation biology conference, Lucas Heights, Australia, 24-25 Aug 1987). In *Conference handbook.* Order Number DE89616297/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

DNA/strand breaks; AUGER EFFECT; DNA; ELECTRONS; GALLIUM 67; IODINE 125

39309 (INIS-mf–11448, pp. 18) **Comparison of γ-ray and neutron induced mutations in DNA.** Singh, S.P. (Queensland Univ., St. Lucia (Australia). Dept. of Biochemistry); Lavin, M.F.; Cohen, D.; Dytlewski, N.; Boldeman, J. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1987. (CONF-8708339–: 11. AINSE radiation biology conference, Lucas Heights, Australia, 24-25 Aug 1987). In *Conference handbook.* Order Number DE89616297/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

DNA/biological radiation effects; DNA; GAMMA RADIATION; MUTATIONS; NUCLEOTIDES; RADIATION DOSES

39310 (INIS-mf–11448, pp. 23) **Thymidine catabolism and ionising radiation.** Shaw, T. (La Trobe Univ., Bundoora (Australia). Dept. of Microbiology); MacPhee, D.G. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1987. (CONF-8708339–: 11. AINSE radiation biology conference, Lucas Heights, Australia, 24-25 Aug 1987). In *Conference handbook.* Order Number DE89616297/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

THYMIDINE/catabolism; BIOLOGICAL RADIATION EFFECTS; DNA; IONIZING RADIATIONS; STRAND BREAKS; THYMIDINE; CATABOLISM

39311 (INIS-mf–11448, pp. 24) **Effect of adenosine 5' - phosphates on 9 - aminoacridine induced mutagenesis in Salmonella typhimurium.** Kopsidas, G. (La Trobe Univ., Bundoora (Australia). Dept. of Microbiology); MacPhee, D.G. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1987. (CONF-8708339–: 11. AINSE radiation biology conference, Lucas Heights, Australia, 24-25 Aug 1987). In *Conference handbook.* Order Number DE89616297/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

MUTAGENESIS/salmonella typhimurium; ACRIDINES; ADENOSINE; DNA; MUTAGENESIS

39312 (INIS-mf–11448, pp. 25) **Thymidine catabolism as an index of toxicity.** Shaw, T. (La Trobe Univ., Bundoora (Australia). Dept. of Microbiology); MacPhee, D.G.; Smillie, R.H. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1987. (CONF-8708339–: 11. AINSE radiation biology conference, Lucas Heights, Australia, 24-25 Aug 1987). In *Conference handbook.* Order Number DE89616297/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

THYMIDINE/catabolism; DNA; THYMIDINE; CATABOLISM; TOXICITY

39313 (INIS-mf–11448, pp. 26) **Effects of ionising radiation on aquatic microenvironments.** Shaw, T. (La Trobe Univ., Bundoora (Australia). Dept. of Microbiology); MacPhee, D.G.; Smillie, R.H. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1987. (CONF-8708339–: 11. AINSE radiation biology conference, Lucas Heights, Australia, 24-25 Aug 1987). In *Conference handbook.* Order Number DE89616297/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

AQUATIC ECOSYSTEMS/biological radiation effects; CATABOLISM; DNA; RADIATION DOSES; THYMIDINE; TOXICITY; UPTAKE

39314 (INIS-mf–11448, pp. 27) **Morphological changes in human melanoma cells following neutron capture therapy.** Barkla, D.H. (Monash Univ., Clayton (Australia)); Allen, B.J.; Brown, J.K.; Mountford, M.; Mishima, Y.; Ichihashi, M. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1987. (CONF-8708339–: 11. AINSE radiation biology conference, Lucas Heights, Australia, 24-25 Aug 1987). In *Conference handbook.* Order Number DE89616297/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

NEUTRON CAPTURE THERAPY/morphological changes; ANIMAL CELLS; BIOLOGICAL RADIATION EFFECTS; CELL DIVISION; GAMMA RADIATION; MELANOMAS; RADIATION DOSES

39315 (INIS-mf–11448, pp. 28) **Maternal immune response to irradiation of mouse embryos.** Nicholls, E.M. (National Centre for Safety Science, University of New South Wales, Kensington (Australia)). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1987. (CONF-8708339–: 11. AINSE radiation biology conference, Lucas Heights, Australia, 24-25 Aug 1987). In *Conference handbook.* Order Number DE89616297/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

EMBRYOS/irradiation; DOSE-RESPONSE RELATIONSHIPS; EMBRYOS; IRRADIATION; GAMMA RADIATION; IMMUNE REACTIONS; LYMPHOCYTES; MICE; RADIATION DOSES

39316 (INIS-mf–11448, pp. 29) **Severe mental retardation following fetal irradiation.** Brown, J.K. (Australian Nuclear Science and Technology Organisation, Lucas Heights (Australia)). Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1987. (CONF-8708339–: 11. AINSE radiation biology conference, Lucas Heights, Australia, 24-25 Aug 1987). In *Conference handbook.* Order Number DE89616297/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

DELAYED RADIATION EFFECTS/mental disorders; BRAIN; DOSE-RESPONSE RELATIONSHIPS; FETUSES; IRRADIATION; NERVE CELLS; RADIOSENSITIVITY

39317 (INIS-mf–11448, pp. 30) **Critical DNA target size model of ionizing radiation-induced mammalian cell death.** Radford, I.R. (Peter MacCallum Cancer Institute, Melbourne (Australia)); Hodgson, G.S.; Matthews, J. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1987. (CONF-8708339–: 11. AINSE radiation biology conference, Lucas Heights, Australia, 24-25 Aug 1987). In *Conference handbook.* Order Number DE89616297/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

DNA/cell killing; ANIMAL CELLS; BIOLOGICAL RADIATION EFFECTS; DNA; STRAND BREAKS

39318 (INIS-mf–11448, pp. 31) **Cell death by apoptosis following X-irradiation of neonatal tissues.** Gobe, G.C. (Queensland Radium Inst., Herston (Australia)); Harmon, B.V.; Allen, D.J.; Axelsen, R.A. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1987. (CONF-8708339–: 11. AINSE radiation biology conference, Lucas Heights, Australia, 24-25 Aug 1987). In *Conference handbook.* Order Number DE89616297/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

CELL KILLING/x radiation; ANIMAL CELLS; BIOLOGICAL RADIATION EFFECTS; IRRADIATION; RADIATION DOSES; RATS

39319 (INIS-mf–11448, pp. 26) **DNA Topoisomerases type I and II in ataxia-telangiectasia.** Lavin, M.F. (Queensland Univ., St.

Lucia (Australia). Dept. of Biochemistry); Kumar, S.; Singh, S.P.; Mohamed, R.; Salmond, C. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1987. (CONF-8708339–: 11. AINSE radiation biology conference, Lucas Heights, Australia, 24-25 Aug 1987). In *Conference handbook.* Order Number DE89616297/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

DNA/isomerases; DNA; ISOMERASES; STRAND BREAKS; TELANGIECTASIS

39320 (INIS-mf–11448, pp. 33) **G2 phase delay in ataxia-telangiectasia and control cell types.** Bates, P.R. (Queensland Univ., St. Lucia (Australia). Dept. of Biochemistry); Poidevin, P. Le; Lavin, M.F. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1987. (CONF-8708339–: 11. AINSE radiation biology conference, Lucas Heights, Australia, 24-25 Aug 1987). In *Conference handbook.* Order Number DE89616297/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

ANIMAL CELLS/radiosensitivity; RADIOSENSITIVITY; BIOLOGICAL RADIATION EFFECTS; TELANGIECTASIS

39321 (INIS-mf–11448, pp. 35) **Evidence for methylation instructed mismatch repair in the chromosomal DNA of CHO cultured cells.** Diver, W. (Peter MacCallum Cancer Institute, Melbourne (Australia)); Woodcock, D. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1987. (CONF-8708339–: 11. AINSE radiation biology conference, Lucas Heights, Australia, 24-25 Aug 1987). In *Conference handbook.* Order Number DE89616297/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

CELL CULTURES/dna repair; CHROMOSOMES; DNA; METHYLATION

39322 (INIS-mf–11448, pp. 36) **Isolation and characterization of HLA-A2 mutant cells.** Janatipour, M. (Flinders Univ. of South Australia, Bedford Park (Australia)); Trainor, K.J.; Kutlaca, R.; Turner, D.R.; Morley, A.A.; Bennett, G.; Hay, J. Australian Inst. of Nuclear Science and Engineering, Lucas Heights (Australia). 1987. (CONF-8708339–: 11. AINSE radiation biology conference, Lucas Heights, Australia, 24-25 Aug 1987). In *Conference handbook.* Order Number DE89616297/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

SOMATIC CELLS/mutations; MONOCLONAL ANTIBODIES; MUTANTS; MUTATION FREQUENCY; MUTATIONS

39323 (INIS-mf–11457(v.1,2) v. 1) **Lung cancer risk assessment of radon-exposed miners on the basis of a proportional hazard model.** Jacobi, W.; Paretzke, H.G.; Schindel, F. Canadian Nuclear Association, Toronto, ON (Canada); Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz. 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

All epidemiological studies on radiation-induced lung cancer indicate that the observed age distribution of lung cancer rate is similar to the expected rate without radiation. On the basis of this general finding a proportional hazard model for the age-specific lung cancer rate as function of Rn-exposure is set up. The promoting influence of smoking is taken into account, using the observed correlations between smokers and nonsmokers in the general population. The derived relationships between lung cancer frequency, exposure, age and followup-time agree with the observed data for uranium miners. The model enables a prediction of lifetime lung cancer risk for different occupational exposure conditions.

39324 (INIS-mf–11457(v.1,2) v. 1) **Epidemiology of radiation effects.** Pochin, E.E. (National Radiological Protection Board, Chilton (UK)). Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Due to the epidemiological records of populations exposed to radiation it is now practical to make good numerical estimates of the risks of radiation at moderate doses and influences of the low-dose risk. Estimates of the effects of radon and radon daughters on induction of lung cancer is discussed. Specific topics addressed are: types of radiation effect, requirements in radiation epidemiology, specification of dose, sensitivity of different organs, needs with regard to population size, conditions needed in a comparison population, and the significance of latent intervals.

39325 (INIS-mf–11457(v.1,2) v. 1) **Practical approach to retrospective estimation of radon daughter concentration in the underground mining environment.** Dory, A.B. (Atomic Energy Control Board, Ottawa, ON (Canada)); Corkill, D.A. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

This paper provides an outline of procedures and methods which could be used to estimate the possible ranges of radon daughter concentrations in any mine, based on known ventilation data and limited number of measurements of radon daughter concentrations. Practical examples of estimation of ranges of radon daughter concentrations are also provided.

39326 (INIS-mf–11457(v.1,2) v. 1) **Differences in 'in vitro' dissolution properties of settled and airborne uranium material.** Scripsick, R.C. (Los Alamos National Lab., NM (USA)); Crist, K.C.; Tillery, M.I.; Soderholm, S.C. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The dissolution behaviour of settled and airborne uranium material produced by firing of depleted uranium munitions was studied using an 'in vitro' dissolution technique. Differences in the composition of bulk and respirable fraction samples of these materials were observed. Dissolution analysis results suggest that under some conditions a rapidly dissolving uranium fraction may be formed. This fraction may play an important role in determining hazard potential associated with inhalation exposure to uranium materials. The fact that a larger rapidly dissolving fraction was observed in the airborne material than in the settled material indicates that dissolution analysis should be performed on appropriate size fraction samples.

39327 (INIS-mf–11457(v.1,2) v. 1) **Biologically significant properties of refined uranium ore.** Eidson, A.F. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM (USA). Inhalation Toxicology Research Inst.); Damon, E.G. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Aerosols produced during normal uranium milling operations were sampled. Assuming a worker inhaled these yellowcake aerosols while not wearing respiratory protection, deposition was predicted to occur in the nasopharyngeal, tracheobronchial and pulmonary compartments of the respiratory tract; but predominantly in the nasopharyngeal compartment. Yellowcake samples were obtained from two mills (Mills A and D) and analyzed. Infrared analysis of Mill A powder showed 82% ammonium diuranate (ADU) and 18% U_3O_8. Mill D powder contained 25% ADU and 75% U_3O_8. 'In vitro' dissolution studies showed that ~85% of Mill A powder had a dissolution half-time ($T_{1/2}$) of < 1 day; the remainder dissolved with $T_{1/2}$=500 days. For Mill D powder, 25% dissolved with $T_{1/2}$ < 1 day, and 75% with $T_{1/2}$=300 days. Clearance of uranium from lungs of rats that inhaled either Mill A or D aerosols agreed with the

above data. For Mill A, 78% cleared with $T_{1/2}$=0.5 days, 22% with $T_{1/2}$=240 days. For Mill D, 25% cleared with $T_{1/2}$ of 3.5 days, 75% with $T_{1/2}$ of 110 days.

39328 (INIS-mf–11457(v.1,2) v. 1) **Comparison of uranium retention in dogs exposed by inhalation to two forms of yellowcake.** Eidson, A.F. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM (USA). Inhalation Toxicology Research Inst.); Damon, E.G.; Hahn, F.F.; Pickerell, J.A. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Forty-four male or female beagle dogs were exposed by inhalation to aerosols generated from yellowcake samples obtained from two uranium mills. The two materials represented two extremes in yellowcake composition that occur in industry: one was 100% ammonium diuranate (ADU); the other was > 99% U_3O_8. Preliminary results from 10 dogs (5 exposed to each aerosol) showed clear differences between the responses to the two forms of yellowcake. Histopathologic examination of kidney tissues showed classic heavy metal toxicity caused by the rapid clearance of inhaled soluble uranium from lung ($T_{1/2}$ = 1.4 days) and translocation of ~ 25% of the initial lung burden to kidney. Maximum kidney concentrations of 8-17 μgU/kg kidney occurred at 4-8 days after inhalation. Proximal tubular necrosis reached its peak between 4 and 64 days after inhalation of soluble yellowcake and was subsequently repaired. There was no kidney damage found in dogs exposed to the less soluble U_3O_8.

39329 (INIS-mf–11459, pp. 34) **Na-24 determination in blood for cases of criticity nuclear accidents.** Rivera, D. (Instituto Peruano de Energia Nuclear, Lima (Peru)); Delmas, C.; Olivera, P.; Zuniga, A. Sociedad Quimica del Peru, Lima (Peru). Oct 1987. (In Spanish). (CONF-8710479–: 15. Peruvian Congress of Chemistry, Lima (Peru), 12-17 Oct 1987). In *Resumenes de los trabajos.* Order Number DE89012192/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

BIOLOGICAL DOSEMETERS/radiation accidents; BIOLOGICAL RADIATION EFFECTS; SODIUM 24

39330 (INIS-mf–11480, pp. 37-38) **Transfer of Cs-137 in aquatic vegetation.** Ahamer, G.; Winkler, S.; Mueller, H. Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik. Nov 1988. (In German). In *Annual report of the Institute for Theoretical Physics in Graz, Austria.* Order Number DE89631627/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

PLANTS/radionuclide migration; SOILS/radionuclide migration; CESIUM 134; CESIUM 137; PLANTS; POTASSIUM 40; PROGRESS REPORT; SOILS; UPTAKE

39331 (INIS-mf–11480, pp. 32) **Distribution of radiocesium in the path: feed - milk -excretions in cows.** Rabitsch, H.; Oswald, K. Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik. Nov 1988. (In German). In *Annual report of the Institute for Theoretical Physics in Graz, Austria.* Order Number DE89631627/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

CESIUM 134/radionuclide kinetics; CESIUM 137/radionuclide kinetics; COWS/cesium 134; COWS/cesium 137; ANIMAL FEEDS; CONTAMINATION; COWS; FECES; MILK; POTASSIUM; PROGRESS REPORT; UPTAKE; URINE

39332 (PNL-SA–16297) **Studying low dose effects using single particle microbeam irradiation.** Braby, L.A.; Reece, W.D. Pacific Northwest Lab., Richland, WA (USA). May 1989. 12p. Sponsored by DOE Energy Research. DOE Contract AC06-76RL01830. (CONF-890517–3: 10. symposium on microdosimetry, Rome, Italy, 21-26 May 1989). Order Number DE89014447/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Our current understanding of the effects of low doses of ionizing radiation relies on extrapolation from doses which are orders of magnitude larger than those resulting from environmental or occupational exposure. Unfortunately these extrapolations are open to skepticism since we do not fully understand the mechanisms responsible for biological effects, and the models used in extrapolation are based of fits to data at higher doses. The stochastic nature of energy deposition by charged particle tracks contributes to the difficulty in measuring effects at low doses. As the dose decreases below $\bar{z}_F$ for the incident radiation and target, the probability of a charged particle crossing a specific cell decreases. A test population then consists primarily of unirradiated cells, with some which have been traversed by one track and a very small fraction which have been traversed by two or more tracks.

39333 (PNL-SA–16533) **Hot particles: Risks, regulations and alara.** Merwin, S.E.; Moeller, M.P. Pacific Northwest Lab., Richland, WA (USA). Jun 1989. 9p. Sponsored by DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-890619–7: 34. annual meeting of the Health Physics Society, Albuquerque, NM, USA, 25-29 Jun 1989). Order Number DE89014925/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In recent years, few areas of health physics have involved as many issues, problems and concerns as exposures of workers to hot particles. Current practices and responses to hot particle contaminations and exposure events have prompted many health physicists and regulators to consider the meaning of ALARA, uniform versus nonuniform exposures, stochastic versus nonstochastic health effects and the concept of dose as an estimation of risk. During this time period, health physicists have been forced to follow current regulations despite concerns that the regulations do not conform to the ALARA principle. The purpose of this paper is to highlight conflicts between the issues stated, such as ALARA, and the current requirements for assessing and recording hot particle exposure events. The significant points to be discussed in this paper are the low probability of a hot particle exposure causing a deleterious health effect, the inappropriateness of comparing extremely nonuniform hot particle exposures to dose limits for uniform exposures, and the inappropriateness of recording a hot particle dose in a worker's dose history as if it were a uniform exposure. 9 refs.

39334 (PNL-SA–16660) **Recommended protocol for standardization in collecting and interpreting radiological environmental data.** Denham, D.H.; Kathren, R.L. Pacific Northwest Lab., Richland, WA (USA). Feb 1989. 5p. Sponsored by DOE Environment Health & Safety. DOE Contract AC06-76RL01830. (CONF-8906120–2: 4. international symposium for the Society of Radiological Protection, Malvern, UK, 4-9 Jun 1989). Order Number DE89014934/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Current reductions in "allowable" levels of radiation and radioactive materials in the environment and an increased public awareness of naturally occurring radioactive materials have reinforced the need for consistency in evaluating the radiological environment. A key concern is the identification and interpretation of environmental levels of radiation and radioactive materials resulting from nuclear facility operations. If these levels can be detected and their source(s) identified, then corrective actions can be taken to eliminate or greatly reduce the environmental impacts of the facility operations. In this paper we address the lack of definitive guidance necessary to determine incremental levels of significance (or insignificance), and we propose a series of protocols to achieve more consistent collection and interpretation of radiological environmental data. 8 refs.

39335 (PNL-SA–16761) **Internal dosimetry, past and future.** Johnson, J.R. Pacific Northwest Lab., Richland, WA (USA). Mar 1989. 14p. Sponsored by DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-8903142–1: Workshop/symposium on radiation protection: past and future, Chalk River, Canada, 20-22 Mar 1989). Order Number DE89014455/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper is a review of the progress in the dosimetry of internally deposited radionuclides (internal dosimetry) since World War II. Previous to that, only naturally occurring radionuclides were available and only a limited number of studies of biokinetics and dosimetry were done. The main radionuclides studied were ^{226}Ra, ^{228}Ra, and ^{224}Ra but natural uranium was also studied mainly because of its toxic effect as a heavy metal, and not because it was radioactive. The effects of ^{226}Ra in bone, mainly from the radium

dial painters, also formed the only bases for the radiotoxicity of radionuclides in bone for many years, and it is still, along with ^{224}Ra, the main source of information on the effects of alpha emitters in bone. The publications of the International Commission on Radiological Protection that have an impact on internal dosimetry are used as mileposts for this review. These series of publications, more than any other, represent a broad consensus of opinion within the radiation protection community at the time of their publication, and have formed the bases for radiation protection practice throughout the world. This review is not meant to be exhaustive; it is meant to be a personnel view of the evolution of internal dosimetry, and to present the author's opinion of what the future directions in internal dosimetry will be. 39 refs., 2 tabs.

39336 (Stralenbescherming–31) **Role of ultraviolet light in the origin of melanomas.** Kamp, A.W.M. v.d.; Baal, J.B.J.M. van; Jaspers, N.G.J.; Bootsma, D.; Erasmus Univ.-Min. VROM Collaboration. Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Directie Stralenbescherming. Mar 1987. 24p. (In Dutch). (VROM–80164/4-88). Order Number DE89631151/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The study described in this report enters into a number of possible functions of UV radiation in the arising of melanomas. From the results it turns out that UV radiation probably does not induce melanomas directly, which pleads for a more direct function of UV radiation possibly via suppression of the defence system against tumour cells. (H.W.). 20 refs.

39337 (Stralenbescherming–39-A) **Damage of human health.** Kal, H.B.; Jansen, J.T.M.; Rotterdam, A. van; Zoetelief, J.; Broerse, J.J.; Ministerie VROM-Radiobiologisch Instituut TNO Collaboration. Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Directie Stralenbescherming. 22 Dec 1988. 138p. (In Dutch). Order Number DE89631197/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Includes list of acronyms; Is also related to TRN NL89C0449.

This report is part of a series of eight reports which have been drawn up on behalf of the Dutch Policy Notition Radiation Standards (BNS). The investigation questions asked in the sub-project 'Human health injuries' concern: the magnitudes by which the different kinds of injuries to health are expressed; the spread of the effective dose equivalent H_{eff} at a given hazard limit for dying by ionizing radiation, in which the genetic component remains out of discussion; the changes of the hazard factors under the influence of recent scientific knowledge; the effects of these upon the spread of the change for dying for individuals, depending on age and sex; risk measures for other kinds of hazard then dying and the spread in terms of a H_{eff} or otherwise, with which practically usable risk measure it can be assessed if for all individuals an acceptable protection level within reasonable spread can be achieved. These questions are answered on the base of recent litera-ture. In chapter one an evaluation is presented of the exposure-risk relations for stochastic effects (tumours, genetic effects) and for remaining forms on health injuries. In chapter 2-4 the information from chapter 1 is elaborated further. The spread of a modified dose equivalent, H_{eff} is evaluated for letal injuries (Chapter 2) and for non-letal health injuries (Chapter 3). In chapter 4 the use of H_{eff} is evaluated. (H.W.). 86 refs.; 8 figs.; 33 tabs.

39338 (Stralenbescherming–39-H) **Synergism.** Bekkum, D.W. van; Radiobiologisch Instituut TNO-MInisterie VROM Collaboration. Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Directie Stralenbescherming. Dec 1988. 32p. (In Dutch). Order Number DE89631198/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Is also affected to TRN NL89C0443-NL89CO448.

This report makes part of a series of eight reports which have been drawn up in behalf of the dutch Policy Notition Radiation Standards (BNS). In this report a survey is given of the actual scientific assumptions concerning the origine of tumours caused by exposure to ionizing radiation and other carcinogentia. !t appears that the process of carcinogenesis is extended over a long period and proceeds probably via a large number of steps (subprocesses). Some of these steps take place under influence of materials or agentia which themselves cannot cause cancer. In this report the term synergisme means all those combinations of carcinogentia and other influences which together have more effect than may be expected on the base of a simple addition. A survey is given of the actually known factors which influence the induction of tumours and of their supposed way of operation. Two examples of tumours which can be induced by radiation and in which synergistic influences can play an important role are elucidated: breast cancer and hormones, and lung cancer and smoking. It is concluded that the influence of synergistic factors upon radiation carcinogenesis has to be evaluated for each tumour type separately. It is recommended, in the assession of the radiation limits, to take into account the specific sensitivity of subpopulations which have been exposed to synergistic factors and in particular for those tumours in which synergistic factors have a large influence. The elaboration of the quantitative meaning of these synergisms for the radiation hazard will require much more research. (author). 32 refs.; 3 figs.; 1 tab.

39339 (WSRC-RP–89-185) **A health physics program for the startup of an enriched uranium naval fuel facility at the Savannah River Site.** Strain, C.D. Westinghouse Savannah River Co., Aiken, SC (USA). 1989. 19p. Sponsored by DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-890619–6: 34. annual meeting of the Health Physics Society, Albuquerque, NM, USA, 25-29 Jun 1989). Order Number DE89014152/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report contains the text to a slide presentation on a health physics program for the startup of an enriched uranium naval fuel facility at the Savannah River Site.

39340 Alteration of the c-mos locus in "normal" tissues from humans exposed to radium. Hardwick, J.P. (Argonne National Lab., IL (USA)); Schlenker, R.A.; Huberman, E. *Cancer Research (USA)*, 49(10): 2668-2673 (15 May 1989).

The structure of a number of human protooncogenes of persons with internal systemic exposure to radium was analyzed by restriction enzyme digestion and Southern blotting of their DNA. Two extra c-mos EcoRI restriction fragment length bands of 5.0 and 5.5 kilobases were found in tissue DNA from six of seven such individuals. The extra c-mos bands were detected in DNA from many, but not all, of the tissues of the individuals exposed to radium. Kidney DNA, however, from three of four individuals exposed to radium contained these alterations; kidney DNA from six age-matched controls did not. The 5.0- and 5.5-kilobase bands, which were of a similar intensity, varied in their intensity with respect to that of the normal 2.5-kilobase band of the c-mos gene. The DNAs that have the polymorphic bands also appear to have a more complex c-mos methylation pattern. Our results suggest that the c-mos restriction fragment length alterations found in individuals exposed to radium were induced rather than inherited, are epigenetic in origin, and most likely result from changes in the methylation of bases surrounding the single exon of the c-mos protooncogene.

5603 Chemicals Metabolism and Toxicology

Refer also to citation(s) 39128, 39175, 39244

39341 (DOE/ER/60524–3) **Malignant transformation of diploid human fibroblasts by transfection of oncogenes: Progress report, July 1986–June 1989.** McCormick, J.J.; Maher, V.M. Michigan State Univ., East Lansing, MI (USA). Carcinogenesis Lab. 1989. 72p. Sponsored by DOE Energy Research. DOE Contract FG02-87ER60524. Order Number DE89013966/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Although there is good evidence that carcinogen exposure is a major cause of human cancer, it has proven impossible to transform normal human fibroblasts or epithelial cells in culture into malignant cells by treating them with carcinogens. This failure may reflect an inability to identify and isolate cells containing one or more premalignant changes so that these can be expanded and exposed to carcinogens a second time to induce additional required changes. A second serious roadblock to the sequential introduction of changes and expansion of clonally-derived cells containing such premalignant changes in the finite life span of human cells in culture. Using

transfection of specific human oncogenes in a series of specially-selected vectors, we have overcome these obstacles and have recently succeeded in generating an infinite life span diploid human cell strain MSU-1.0, which appears to be normal in all other characteristics. From that cell a second cell strain, MSU-1.1, was generated which we have been able to transform into a malignant state not only by transfecting the cells with oncogenes but also by treating them with chemical carcinogens. We now have evidence that there is not just a single linear process which results in malignant transformation. Rather, cells appear to progress to malignancy on a series of parallel, sometimes overlapping tracks. We now propose to carry out detailed studies of the specific mechanisms of malignant cell transformation using the cell strains available in this laboratory to achieve the goal of building relevant quantitative models of carcinogenesis. 29 refs.

39342 (PNL-SA–16167) **Can carcinogenicity be predicted from chemical analysis and DNA adduction.** Mahlum, D.D.; Mann, D.LB.; Dankovic, D.A.; Springer, D.L. Pacific Northwest Lab., Richland, WA (USA). Oct 1988. 16p. Sponsored by DOE Energy Research. DOE Contract AC06-76RL01830. (CONF-8810209–13: 27. Hanford life sciences symposium on health and the environment, Richland, WA, USA, 18-21 Oct 1988). Order Number DE89014931/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Tumorigenicity of mixtures is often considered to be a sum of the tumorigenicity of individual components of the mixture. We have presented evidence that this may not be so for mixtures derived from the liquefaction of coal. Tumor initiation is considered to be a genetic event in which the DNA is altered by adduction by a carcinogenic chemical or by a physical agent such as ionizing radiation. DiGiovanni et al (1982) have presented evidence that mouse skin tumor initiating activity is closely correlated with the level of DNA adduction. In this paper, we examine the relationship between chemical composition of mixtures and their skin tumor initiating activity. We also examine the effect of mixtures on the skin tumor initiating activity and the adduction of DNA by benzo[a]pyrene (BaP). These studies involve predicting the carcinogenicity of mixtures from their chemical composition and the use of DNA adduct formation rather than chemical composition as it is a better indicator of tumor initiating activity. 4 refs., 6 figs., 1 tab.

39343 Evaluation and testing of totally encapsulating chemical protective suits. Johnson, J. (Lawrence Livermore National Lab., Livermore, CA (US)). v.v of Proceedings of the fourth annual hazardous materials management conference. Tower Conf. Management Company, Wheaton, IL (1986). (CONF-860695–: HazMat '86: hazardous materials management conference and exhibition, Atlantic City, NJ, USA, 2-4 Jun 1986).

Testing total encapsulating chemical protective suits (TECP suits) is the final step in assuring that a new TECP suit design is acceptable for field use or that a decontaminated or repaired TECP suit is acceptable for reuse. To better understand the complicated nature of this problem, one must first remember that there are two types of TECP suits: the Type I suit provides complete encapsulation of the self-contained breathing apparatus (SCBA) and the person; the Type II suit, on the other hand, provides complete encapsulation of the person, but the SCBA is located on the outside of the suit. Both types of suits contain the following exterior components that determine the suit's ability to provide an interior environment free of hazardous chemicals: lens, suit closure, vent valves, suit membrane, seams, gloves, and boots. The Type II suit also exposes the entire SCBA to the hazardous chemical environment, therefore requiring that additional chemical effects data be evaluated.

5604 Other Environmental Pollutant Effects

39344 (LA-UR–89-1731) **Variational principles for the return current in encephalography.** Heller, L. Los Alamos National Lab., NM (USA). 1989. 4p. Sponsored by DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-890849–3: 7. international conference on biomagnetism, New York, NY, USA, 14-18 Aug 1989). Order Number DE89013437/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The total electric current within the brain has been written as a sum of two terms, of distinctly different nature. The first, $\vec{J}^{\,i}$, is the 'primary' or 'impressed' intracellular current that flows within the neurons, and is the quantity of interest in neuroscience. This current leaks across the cell membrane, however, and since the cells are embedded in an electrically conducting medium the extracellular ('return') current flows through a large volume of this medium before returning to the cell. With the return current written as the product of the conductivity σ and the electric field intensity $\vec{E} = -\nabla V$, at low frequencies the electric potential V is determined by the continuity equation. 9 refs.

39345 (LA-UR–89-2221) **A modality-specific neuromagnetic P3.** Flynn, E.R.; Lewine, J.D.; Oakley, M.T.; Roeder, S.B.; Arthur, D.L.; Aine, C.J.; George, J.S. Los Alamos National Lab., NM (USA). 1989. 5p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890849–4: 7. international conference on biomagnetism, New York, NY, USA, 14-18 Aug 1989). Order Number DE89014468/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Several studies indicate that in cases of psychopathology and alcoholism the amplitude and/or latency of endogenous, scalp-recorded P3 potentials elicited by rare events are abnormal. The P3 complex may normally be a valuable index of the brain's work-load and identification of the neural generator(s) of this late positive component would thus provide valuable insight into the substrates of both normal and abnormal information processes. Okada and his colleagues have recorded magnetic field correlates of P3 potentials evoked by visual and auditory stimuli. Data from a mapping study of a visually evoked magnetic P3 were consistent with a hippocampal source, but attempts to localize the generator(s) of the auditory magnetic P3 were unsuccessful. In an effort to independently confirm, extend, and clarify these results, the surface topographies of magnetic P3-like complexes evoked during the performance of auditory and visual detection tasks were examined. 6 refs., 2 figs.

39346 (OTA-BP-E–53) **Biological effects of power frequency electric and magnetic fields: Background paper.** Nair, I.; Morgan, M.G.; Florig, H.K. Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Engineering and Public Policy. 1989. 103p. Available from GPO06/MF A01 - OSTI.

Electric and magnetic fields produced by electric power systems have recently been added to the list of environmental agents that are a potential threat to public health. This paper describes peoples' exposures to fields from power systems and other sources, reviews existing scientific evidence on the biological effects of these fields, presents a history of research support and of regulatory activity, and discuss problems and alternatives in regulatory action. 210 refs.

57 HEALTH AND SAFETY

39347 (INIS-mf–11457(v.1,2) v. 2) **Computer modelling of airborne alpha radiation in mines.** Notley, K.R. (Queen's Univ., Kingston, ON (Canada). Dept. of Mining Engineering); Fytas, K.G.; Wheeler, J. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

This paper describes the main features of VENTRAD, a computer program which models radon-related contamination in mine airways. Used in conjunction with a conventional mine ventilation network analysis program which establishes a flow distribution, the program clearly illustrates a number of features concerning radon-related contamination which are not obvious from the application of radon growth theory to individual airways. The inter-relation of contamination levels in various airways under different ventilation strategies may be studied. It is possible to simulate point sources of contamination and the effects of leakage and short-circuiting of air currents.

39348 (UCRL–50007-87, pp. 87-92) **Determination of the effectiveness and proper funding level of safety programs.** Kolar,

O.C. Lawrence Livermore National Lab., CA (USA). Jul 1988. In *Hazards Control Department annual technology review, 1987.* Order Number DE89002470/JAW. Available from NTIS, PC A07/MF A01.

The author proposes a quantitative approach for planning and justifying resource allocations for safety organizations. He first develops data on the total safety cost (cost of incidents plus program cost) and compare this with the resources allocated to safety at a facility. With a sufficient number of data points from other DOE safety organizations, an optimum value for the amount of resources a facility should allocate to safety can be determined. This paper describes the method and reasoning and shows how the quantitative technique can be applicable throughout the DOE community. 4 references.

58 GEOSCIENCES

5801 Geology and Hydrology

Refer also to citation(s) 38136

39349 Some techniques for stochastic modeling of three-dimensional fracture networks. Hestir, K. (Lawrence Berkeley Lab., CA (USA)); Long, J.; Chiles, J.P.; Billaux, D. pp. 658 of Geostatistical, sensitivity, and uncertainty methods for ground-water flow and radionuclide transport modeling. Proceedings. Buxton, B.E. (ed.) Battelle Memorial Institute, Columbus, OH (1989). DOE Contract AC03-76SF00098. From Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference; San Francisco, CA, USA; 15-17 Sep 1987.

This paper describes some new techniques for stochastic modeling of three-dimensional fracture networks. We use geostatistical simulation methods to reproduce features of the spatial structure of the rock such as the variation of fracture density and fracture orientation in space. For an example of the method we use mapped fracture data from the Fanay-Augeres mine, in Limousin, France. Two different sections of a drift wall, S1 and S2, were mapped. The S1 section is wet, and the S2 section is dry. For each case, the fractures are divided into five different sets and each set is modeled separately. The fractures in each set are represented as discs placed randomly in space. The diameter of each disc is chosen independently from a fixed probability distribution determined from the trace length distribution. For the location of discs a point process called the parent-daughter process is used. This process gives a clumping or swarming of fractures not found in the usual Poisson model. The orientation of the discs is characterized as a fluctuation about the mean orientation for the set. This fluctuation has a spatial structure that is simulated with geostatistics. Geostatistical simulations of the two fracture systems are under way. The connectivities of the simulations will be assessed to see if there is any correlation with the fact that the S1 section of drift is wet and the S2 section is dry.

39350 (DOE/ER/60594–T1) **Surface hydrology, sediment transport dynamics, and remote sensing of disturbed watersheds in a humid temperate region: Progress report.** Pennsylvania State Univ., University Park, PA (USA). [1989]. 8p. Sponsored by DOE Energy Research. DOE Contract FG02-87ER60594. Order Number DE89014850/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The fundamental goal of this three-year research effort is to: (1) quantify the temporal evolution of the hydrologic cycle on disturbed watersheds and (2) construct a modular hydrologic model that uses, as primary input, variable quantities an types of remotely sensed data sets in a geographic information systems (GIS) format. The hypothesis to be tested states that the geomorphic evolution of disturbed watersheds which are in disequilibrium can be quantified with field data and subsequently modeled, utilizing both field-derived and remotely sensed data sets. We will quantify the temporal evolution and physical relationships of the hydrologic cycle on disturbed watersheds incorporating physically based and statistically derived equations into a predictive landscape evolution model, and develop a modular hydrologic model that predicts watershed hydrology and uses variable qualities and types of remotely sensed data as primary input. 4 figs.

39351 Isotopic evidence on the structure and origin of subcontinental lithospheric mantle in southern Nevada. Farmer, G. L. (Department of Geological Sciences and Cooperative Institute for Research in Environmental Science, University of Colorado, Boulder(US)); Perry, F. V.; Semken, S.; Crowe, B.; Curtis, D.; DePaolo, D. J. *Journal of Geophysical Research (USA),* 94(B6): 7885-7898 (10 Jun 1989).

The trace element and Nd, Sr, and Pb isotopic compositions of extension-related late Cenozoic basalts in southern Nevada were determined in order to constrain models for the tectonic evolution of the subcrustal mantle in the southern Great Basin since 10 Ma. Basalts in southern Nevada between latitudes 36°N and 37°N have low ε_{Nd}(−8 to −10), high Δ8/4(+70 to +107) and Δ7/4 (+8 to +12), high $^{87}Sr/^{86}Sr$, and low high field strength element (HFSE) concentrations relative to other Basin and Range basalts. Basalts with these chemical and isotopic traits have erupted semicontinuously in southern Nevada since 10 Ma. During the same period of time, basalts in central Nevada and east central California have shifted toward higher ε_{Nd}, lower $^{87}Sr/^{86}Sr$, lower Δ8/4 and Δ7/4, and higher HFSE contents than observed for the southern Nevada basalts.

5802 Geophysics

Refer also to citation(s) 38175, 38180, 38423

39352 (EPRI-NP–6389) **Proceedings: Engineering characterization of small-magnitude earthquakes.** McCann, M.W. Jr.; Reed, J.W. Electric Power Research Inst., Palo Alto, CA (USA); Benjamin (J.R.) and Associates, Inc., Mountain View, CA (USA). c 1987. 348p. Sponsored by Electric Power Research Institute. (CONF-8701161–: Workshop on engineering characterization of small-magnitude earthquakes, Palo Alto, CA (USA), 27-29 Jan 1987). Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

A three-day workshop was held on the engineering characterization of small-magnitude earthquakes in Palo Alto on January 27-29, 1987. The workshop was sponsored by the Electric Power Research Institute. The objective of the workshop was to consider a broad range of issues that could provide insight to the engineering significance of ground motion generated by small-magnitude earthquakes. Based on the presentations at the meeting it was intended to develop a strategy to select a lower-bound magnitude for use in seismic hazard assessments. An Advisory Committee reviewed the information presented at the workshop and provided recommendations concerning the level of earthquake magnitude that may be damaging to nuclear power plant structures and equipment and a strategy to establish a sound basis to determine the lower-bound magnitude. These proceedings contain the technical papers presented at the workshop, summaries of the discussion sessions and the recommendations of the Advisory Committee. Individual papers were processed separately for the data base.

39353 (SAND–88-3431) **Volcanic eruptions and research drilling in the Inyo Domes Chain, Inyo National Forest, California.** McConnell, V.S.; Eichelberger, J.C. Sandia National Labs., Albuquerque, NM (USA). Jun 1989. 25p. Sponsored by DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. Order Number DE89013900/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This nontechnical report describes the Inyo Domes Chain drilling project and explains the conclusions drawn from study and analysis of the drill core. 12 figs.

39354 Determination of fault planes at Coalinga, California, by analysis of patterns in aftershock locations. Fehler, M. (Los Alamos National Laboratory, Los Alamos, New Mexico(US)); Johnson, P. *Journal of Geophysical Research (USA),* 94(B6): 7496-7506 (10 Jun 1989).

The May 2, 1983, Coalinga, California, earthquake was not anticipated because it took place along a previously unrecognized fault concealed beneath an anticline, in a region that had little historic seismicity. The main shock hypocenter was at 10 km depth, and faulting did not break the surface. There has been considerable controversy about which of the nodal planes from the main shock fault plane solution was the slip plane. Conflicting results from

geodetic, geologic, and aftershock data imply that slip occurred along one or the other or both nodal planes. The aftershock zone is large; several planar features within the aftershock zone indicate that faulting was complex. To delineate the planes of slip, we applied the three-point method, a statistical technique by which event planes can be determined from aftershock locations. We obtained several important results from our study. First we identified a number of planes using locations of aftershocks, some of which have not been previously identified from visual inspection of the aftershock locations. Second, the method allows us to choose slip planes by associating three-point planes with fault plane solutions based on proximity and similar orientation. Finally, three of the planes identified by the method intersect near the main shock hypocenter, making it difficult to determine which plane is the main shock slip plane. Nevertheless, aftershocks during the first 24 hours after the main shock clearly define the high-angle NE dipping nodal plane, whereas few aftershocks were located along the conjugate plane. Assuming that the aftershocks took place along the rupture zone, we conclude that slip during the main shock occurred predominantly along the high-angle NE dipping plane from the fault plane solution for this event. © American Geophysical Union 1989

39355 **The 1987 southeastern Alaska gravity calibration range: Absolute and relative gravity measurements.** Sasagawa, G. S. (Institute of Geophysics and Planetary Physics, Scripps Institution of Oceanography, University of California, San Diego, La Jolla(US)); Zumberge, M. A.; Stevenson, J. M.; Lautzenhiser, T.; Wirtz, J.; Ander, M. E. *Journal of Geophysical Research (USA)*, 94(B6): 7661-7666 (10 Jun 1989).

In June 1987 a gravimeter calibration range was set up in southeastern Alaska and the Yukon territory, as part of a geophysical determination of the Newtonian gravitational constant. Absolute gravity measurements were made between the range endpoints using the Institute of Geophysics and Planetary Physics absolute gravity meter. The calibration range spans 171.841±0.014 mGal, with a midpoint g value of 9.81746500 ms^{-2}. Relative gravity meters, including a LaCoste and Romberg borehole gravity meter, were read along this range. A scale factor correction (SFC) for borehole meter 14 was found to be $(8.1\pm1.5)\times10^{-4}$, and for meter G-349 the correction was $(-3.3\pm1.7)\times10^{-4}$. The SFC for meter D-85 has an upper bound of $\pm1.0\times10^{-4}$. © American Geophysical Union 1989

39356 **Basaltic volcanism in Ethiopia: Constraints on continental rifting and mantle interactions.** Hart, W. K. (Geology Department, Miami University, Oxford, Ohio(US)); WoldeGabriel, G.; Walter, R. C.; Mertzman, S. A. *Journal of Geophysical Research (USA)*, 94(B6): 7731-7748 (10 Jun 1989).

Middle to late Cenozoic mafic lavas from the Ethiopian volcanic province exhibit considerable chemical and isotopic diversity that is linked to eruption age and eruption location. These variations provide a geochemical framework in which continental rifting can be examined. Trace element and Sr, Nd, and Pb isotopic data are interpreted to indicate involvement of up to two depleted and two enriched mantle reservoirs throughout Cenozoic rift development in Ethiopia. Superimposed on the characteristics imparted by varying degrees of melting of these distinct reservoirs are the effects of crystal fractionation and, in some instances, crustal contamnation. Initial stages of Oligocene rifting and volcanism, as manifested by the rift-bounding plateau flood basalts, are attributed to asthenospheric upwelling and melting of a heterogeneous, enriched subcontinental lithospheric mantle. Mildly alkaline lavas were produced from an enriched source with characteristics similar to those of the inferred source of other mantle–derived lavas and xenoliths from east Africa (LoNd array, EMI to HIMU). Contemporaneous tholeiitic lavas were derived from a source similar to that producing oceanic basalts from Samoa and the Society Islands (EMII). As lithospheric thinning and rifting continued into the Miocene, upwelling depleted asthenosphere (depleted OIB reservoir, PREMA) interacted with the lithospheric sources producing lavas with hybrid elemental and isotopic characteristics (11-6 Ma plateau and rift margin basalts).

39357 **Southern Cordilleran Basaltic Andesite suite, southern Chihuahua, Mexico: A link between Tertiary continental arc and flood basalt magmatism in the North America.** Cameron, K. L. (Earth Sciences, University of California, Santa Cruz(US)); Nimz, G. J.; Kuentz, D.; Niemeyer, S.; Gunn, S. *Journal of Geophysical Research (USA)*, 94(B6): 7817-7840 (10 Jun 1989).

Mid-Cenozoic orogenic andesites and ignimbrites of western Mexico, southwestern New Mexico, and Arizona are commonly capped by basaltic andesites, most from 29–20 Ma. We refer to these mafic lavas as the Southern Cordilleran Basaltic Andesite (SCORBA) suite, and they may constitute the most extensive Cenozoic basaltic suite in North America. The SCORBA suite has trace element and isotopic characteristics of orogenic (arc) rocks (i.g., Ba/Nb>40), and silica content (53–56% SiO_2) like the Grande Ronde Basalt, which represents about 80% of the volume of the Columbia River Group. Geochemical and isotopic data are presented on SCORBA lavas and rare mafic lavas (PRE-SCORBA) interlayered with older ignimbrites from a 700-km-long NE-SW transect of southern Chihuahua, Mexico. SCORBA and PRE-SCORBA lavas with relatively low K/P (<7) and differing Ba/Nd (50 versus 18) have similar isotopic compositions, arguing against their isotopic signatures being controlled by crustal assimilation. Along the entire length of the transect, the basaltic rocks have ε_{Nd} and $^{87}Sr/^{86}Sr$ near bulk Earth and $^{206}Pb/^{204}Pb$ and $^{207}Pb/^{204}Pb$ ratios that lie along a 1.7 Ga pseudoisochron. The Pb isotopic variation is geographically controlled, becoming more radiogenic from east to west, reflecting mixing in mantle source regions. The eastern mantle source has low $^{206}Pb/^{204}Pb$ and is a mixture of an enriched, enriched-mantle-like (EMI) component with one or more depleted components, which could include an intraplate component with relatively high Nb/Y (>0.8).

5803 Mineralogy, Petrology, and Rock Mechanics

Refer also to citation(s) 38083, 38156

39358 **Analysis of borehole breakouts.** Zheng, Z. (Earth Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley(US)); Kemeny, J.; Cook, N. G. W. *Journal of Geophysical Research (USA)*, 94(B6): 7171-7182 (10 Jun 1989).

Boreholes drilled into rock, which is subjected to stresses that amount to a significant fraction of the strength of the rock, may cause the rock to fail adjacent to the borehole surface. Often this results in the elongation of the cross section of the borehole in the direction of the minimum principal (compressive) stress orthogonal to the borehole axis. Such breakouts are valuable indicators of the direction of the minimum compressive stress orthogonal to the axis of the borehole. Their shapes may provide information about the magnitudes of both the maximum and minimum stresses relative to the strength of the rock. Borehole breakouts also may be impediments to drilling and to in situ measurement techniques, such as hydraulic fracturing. Observations and analyses of borehole breakouts raise three important questions. First, how does the shape of the borehole breakout evolve? Second, why are breakout shapes stable despite the very high compressive stress concentrations that they produce? Third, how is the shape of the breakout related to the magnitudes of the stresses in the rock? In this paper, extensile splitting of rock in unconfined, plane strain compression is assumed to be the process of rock failure adjacent to the circumference of the borehole, by which a breakout forms. To simulate the evolution of a borehole breakout, this process is combined with a numerical boundary element analysis of the stresses around a borehole as its cross section evolves from the originally circular shape to that of a stable breakout.

5804 Geochemistry

Refer also to citation(s) 37967, 38061, 38842

39359 (DOE/ER/13416–4) **Geochemistry and origin of regional dolomites: Annual progress report, July 26, 1988–April 15, 1989.** Hanson, G.N.; Meyers, W.J. State Univ. of New York, Stony Brook, NY (USA). Apr 1989. 25p. Sponsored by DOE Energy Research. DOE Contract FG02-85ER13416. Order Number DE89015442/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Previous petrographic and geochemical work on Burlington-Keokuk Fm. dolomites has recognized common non-dolomite phases as inclusions in dolomites and as interstitial material. In order to fully understand and interpret whole-rock geochemistry of

dolomites and dolomite separates (Pb isotopes, B isotopes, Sr isotopes, Fe and Mn chemistry) it is essential to identify the contributions from these phases, and to determine their age relationships to the dolomites. A study of the solid inclusions and associated interstitial non-dolomite phases is currently under way mainly by W.J. Meyers, but in collaboration with the other Burlington workers. The study is using reflected light microscopy, SEM backscatter and secondary electron imaging, on thin sections, fractured surfaces, and impregnated and polish stubs, portions of which have been artificially etched with formic acid. Work over the coming year will include TEM, X-ray diffraction and electrode probe work. The samples studied are from localities for which we have geochemistry, detailed petrography (including porosity and permeability), and which contain both major generations (dolomite I and II). One of the important conclusions to date is that solid inclusions in dolomites are relatively rare, yet non-carbonate material is nearly ubiquitous in dolostones as inter-rhomb phases. A large part of the effort thus far has been to identify the inter-rhomb material as well as the intra-rhomb inclusions, and to interpret their timing relationships to dolomite. A corollary of this finding is that most inclusions seen transmitted light are probably fluid inclusions.

5805 Oceanography

Refer also to citation(s) 38320, 39112

39360 (DOE/ER/13361–4) **[Summer investigations into the isolation, cultivation and metabolism of anaerobes involved in biodegradation]: Progress report, year 4, summer 1988.** Marine Biological Lab., Woods Hole, MA (USA). 1988. 5p. Sponsored by DOE Energy Research. DOE Contract FG02-85ER13361. Order Number DE89015101/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In the laboratory our students were trained in modern techniques for the isolation and study of a wide variety of microbes from marine and brackish environments. Special emphasis was placed on anaerobes and archaebacteria. Microbial groups that were studied included the propionic bacteria, clostridia, methanogens, acetogens, hydrogen oxidizing anaerobes and aerobes, sulfate-reducing bacteria and sulfur-reducing bacteria, anoxic photosynthetic bacteria, cyanobacteria, spirochetes, symbiotic and non-symbiotic nitrogen fixing bacteria, luminescent bacteria, iron bacteria, magnetic bacteria, and sulfur oxidizing bacteria. The permanent staff led discussions and presented lectures on the metabolism, physiology and biochemistry of the groups listed above. Material was also presented on motility and chemotaxis of bacteria, and particular emphasis was given to molecular approaches to studying evolution of bacteria. We also had five successful Microbiology Mini-symposia (see attached schedule). These one-day symposia involved lecture/seminar presentations by investigators involved in state-of-the-art working particularly exciting areas within the scope of our course.

39361 (DOE/ER/60333–7) **California Basin Study (CaBS): Circulation and particle fluxes in the California bight: Six month progress report, May 15, 1989–November 14, 1989.** Hickey, B. Washington Univ., Seattle, WA (USA). School of Oceanography. 1989. 26p. Sponsored by DOE Energy Research. DOE Contract FG05-85ER60333. Order Number DE89015092/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The following gives a brief summary of grant activities during the first six months of the new grant. During this period we have continued to edit and process data collected from the ten CTD/transmission/oxygen surveys. In addition, we continue to process George Jackson's cruise samples (at no cost to Jackson). The first three cruises have been completed. The next three should be completed within the six-month period. We have been experiencing computer difficulties: the PRIME computer is no longer supported by the School of Oceanography and we will ultimately be required to change processing systems. The Department of Energy, California Basin Study Program continued with the CaBS-10, Leg 2 cruise onboard the R/V New Horizon which departed from San Pedro, California on October 1, 1988 and returned to San Diego, California on October 7, 1988. The cruise was multi-disciplinary in nature involving physical, chemical, and biological measurements. The weather and seas were good, so that no time was lost due to weather or sea state. Captain Muench and the crew of the New Horizon were all very cooperative and helpful. Restrictions imposed by the Pacific Missile Range, and by the positioning of all the current meter moorings on the eastern side of the basins altered the scheduling and limited the number of our CTD stations in the western basins somewhat. However, we met all of our projected goals of sampling and of mooring recovery and deployment, and occupied 102 CTD stations, more than on any previous CaBS cruise.

64 PHYSICS I

6401 Astrophysics and Cosmology

Refer also to citation(s) 39449, 39460, 39495, 39660

39362 (DOE/ER/40085–16) **An underground search for an excess muon flux from the direction of Cygnus X-3.** Kochocki, J.A. Tufts Univ., Medford, MA (USA). c 15 Jun 1989. 166p. Sponsored by DOE Energy Research. DOE Contract AC02-83ER40085. Order Number DE89014935/JAW. Available from NTIS, PC A09/MF A01 - OSTI; GPO Dep.

During the period July, 1987 through March, 1988 (livetime 0.5 year) an array of 128 proportional wire modules, arranged in two planes (each of two crossed layers) separated by 10 m, and with effective overlap areas of 35 m^2, was operated as an underground muon detector. The detector is located at a depth of 2100 meters of water equivalent in northern Minnesota (92.2° W, 47.7°N). The response time for the proportional tubes is 1 μs and the overall angular resolution is 2°. Absolute timing information (~1 ms) was available for most of the 250,000 recorded triggers. A sample of the total data consisting of 103,000 reconstructed, single muon tracks, was used to search for an excess muon flux from the direction of the astronomical point source, Cygnus X-3. We report an integrated excess flux from that direction of $(6\pm2) \times 10^{-11}$ $cm^{-2}s^{-1}$. The vertical muon flux was also measured and found to be $(1.2\pm0.3) \times 10^{-3}m^{-2}s^{-1}sterad^{-1}$. 65 figs., 5 tabs.

39363 (DOE/FTR–9015463) **Solar physics, France, Italy, May 18, 1989–June 7, 1989: Foreign trip report.** Hahn, R.L.; Weneser, J. Brookhaven National Lab., Upton, NY (USA). 30 Jun 1989. 28p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH00016. Order Number DE89015463/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The International Conference, "Inside The Sun", was designed to bring together, in an "ecumenical" atmosphere, experts from the different specialized fields that comprise the subject of solar physics. In general, this aim was accomplished, with ≈180 scientists representing 25 countries in attendance at the meeting. R.L. Hahn and J. Weneser were the attendees from Brookhaven National Laboratory. All of the major areas of solar physics were addressed in Versailles. The conference demonstrated the progress that has been made in understanding solar dynamics, but this progress also serves to sharpen and define the "puzzles" that remain – of which the so-called "solar neutrino puzzle" is foremost. The solar neutrino experiments has a particularly important place in the discussions a Versailles, because they remain as the only means of truly "seeing" inside the sun. Progress on the GALLEX and SAGE experiments was reported. The report on the SAGE experiment by V. Gavrin also revealed that some unexplained, serious problems have arisen in tests of their experimental design.

39364 Observation of ^8B solar neutrinos in the Kamiokande-II detector. Hirata, K. S. (Institute for Cosmic Ray Research, University of Tokyo, Tanashi, Tokyo 188, Japan(JP)); Kajita, T.; Kifune, T.; Kihara, K.; Nakahata, M.; Nakamura, K.; Ohara, S.; Oyama, Y.; Sato, N.; Takita, M.; and others. *Physical Review Letters (USA)*, 63(1): 16-19 (3 Jul 1989).

Neutrinos from the decay of ^8B in the Sun have been observed in the Kamiokande-II detector. Based on 450 days of data in the time period January 1987 through May 1988; the measured flux obtained from data with $E_e \geq 9.3$ MeV is $0.46\pm0.13(stat)\pm0.08(sys)$ of the value predicted by the standard solar model. Within experimental

errors, the Kamiokande-II value is in agreement with the corresponding value obtained in the ^{37}Cl radiochemical detector in essentially the same time period.

39365 Scale problem in wormhole physics. Kim, J. E. (Department of Physics, Brown University, Providence, Rhode Island 02912(US)); Lee, K. *Physical Review Letters (USA),* 63(1): 20-23 (3 Jul 1989).

Wormhole physics from the quantum thoery of gravity coupled to the second-rank antisymmetric tensor or Goldstone-boson fields leads to an effective potential for these fields. The cosmological energy-density bound is shown to put an upper bound on the cosmological constant which wormhole physics can make zero. This upper bound, of order 10^{11} GeV, is far smaller than the Planck scale and barely compatible with the possible cosmological constant arising from grand unified theories. In addition, the effect of wormholes on the axion for the strong *CP* problem is discussed.

39366 Inhomogeneous nucleosynthesis and the cosmic-microwave-background isotropy. Schaefer, R. K. (Physics Department, Ohio State University, Columbus, Ohio 43210(US)). *Physical Review [Section] D: Particles and Fields (USA),* 40(2): 271-276 (15 Jul 1989).

It has been known for some time that the standard big-bang nucleosynthesis(described by Yang *et al.*) puts strong limits on the amount of baryonicmatter in the Universe. The recently proposed inhomogeneous nucleosynthesiscould potentially invalidate that bound. In view of this possibility, we reviewthe predictions of the cosmic-microwave-background anisotropy, which isexpected to be overproduced in most pure baryonic universes when one tries toexplain the formation of galaxies. We show that these predictions are notlikely to be modified by hiding the baryons in "lumps" left over from the QCDphase transition.

39367 Fragmentation of cosmic-string loops. York, T. (NASA Fermilab Astrophysics Center, Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510(US)). *Physical Review [Section] D: Particles and Fields (USA),* 40(2): 277-281 (15 Jul 1989).

The fragmentation of cosmic-string loops is discussed and the results of asimulation of this process are presented. The simulation can evolve any of alarge class of loops essentially exactly, including allowing fragments thatcollide to join together. Such reconnection enhances the production of smallfragments, but not drastically. With or without reconnections, thefragmentation process produces a collection of non-self-intersecting loopswhose typical length is on the order of the persistence length of the initialloop.

39368 Neutrino helicity flips via electroweak interactions. Gaemers, K. J. F. (Nationaal Instituut voor Kernfysica en Hoge-Energiefysica, P.O. Box 41882, 1009DB Amsterdam, The Netherlands(NL)); Gandhi, R.; Lattimer, J. M. *Physical Review [Section] D: Particles and Fields (USA),* 40(2): 309-314 (15 Jul 1989).

Electroweak mechanisms via which neutrinos may flip helicity are examined in detail. Exact and approximate expressions for a variety of flip processes relevant in astrophysics and cosmology, mediated by *W*, *Z*, and γ exchange, including their interference, are derived for both Dirac and Majorana neutrinos (with emphasis on the former). It is shown that in general flip and nonflip cross sections differ by more than just a multiplicative factor of $m_\nu{}^2/4E_\nu{}^2$ contrary to what might be expected and that this additional dependence on helicities can be significant. It is also shown that within the context of the standard model with massive neutrinos, for $\nu e \rightarrow \nu e$ scattering, $\sigma_Z{}^{flip}/\sigma_\gamma{}^{flip} \approx 10^4$, independent of particle masses and energies to a good approximation. As an application, using some general considerations and the fact that the observed $\bar{\nu}_e$ burst from SN 1987A lasted several seconds, these weak-interaction flip cross sections are used to rule out μ and τ neutrino masses above 30 keV. Finally, some other consequences for astrophysics in general and supernovae in particular are briefly discussed.

39369 Anisotropic thermal electron distributions in the solar wind. Phillips, J. L. (Los Alamos National Laboratory, Los Alamos, New Mexico (US)); Gosling, J. T.; McComas, D. J.; Bame, S. J.; Gary, S. P.; Smith, E. J. *Journal of Geophysical Research (USA),* 94(A6): 6563-6580 (1 Jun 1989).

Solar wind thermal electrons are normally nearly isotropic, with a temperature ratio, $T_\parallel/T_\perp$, of 1.2 or less. This study presents ISEE 3 observations of unusually anisotropic ($T_\parallel/T_\perp$=1.5 to 4) electron distributions in the solar wind near 1 AU. The highly anisotropic events generally share the following characteristics: (1) they have unusually low density, and (2) they are located in the rarefaction regions on the trailing edges of high-speed streams. Correlation of the electron temperature ratio with other solar wind parameters over a full range of $T_\parallel/T_\perp$ shows a distinct negative correlation with electron density and reveals that the anisotropies are caused by high $T_\parallel$ rather than by low $T_\perp$. A simple numerical model illustrates that these effects can be described by the competing processes of solar wind expansion and isotropization via Coulomb self-collisions. However, disagreement between model predictions and observations suggests the need for consideration of other mechanisms, including wave-particle interactions, for repartitioning of electron energy between the parallel and perpendicular components. The periods of extreme electron anisotropy tend to be coincident with intervals of double ion beams, suggesting similar causal mechanisms for the two phenomena. We concluded that certain aspects of the thermal anisotropies can be explained in a simple manner but that complete understanding will require analysis of additional factors such as collisions in nonthermal distributions and the radial evolution of solar wind structures.

39370 Electron heat flux dropouts in the solar wind: evidence for interplanetary magnetic field reconnection?. McComas, D. J. (Los Alamos National Laboratory, Los Alamos, New Mexico (US)); Gosling, J. T.; Phillips, J. L.; Bame, S. J.; Luhmann, J. G.; Smith, E. J. *Journal of Geophysical Research (USA),* 94(A6): 6907-6916 (1 Jun 1989).

Electron heat flux dropout events have been observed in the solar wind using the ISEE 3 plasma electron data set. These events manifest themselves as dropouts of the solar wind halo electrons which are normally found streaming outward along the local magnetic field. These dropouts leave nearly isotropic distributions of solar wind halo electrons, and consequently, the heat flux in these events is reduced to near the observational noise level. We have examined ISEE 3 data from shortly after launch (August 16, 1978) through the end of 1978 and identified 25 such events ranging in duration from 20 min to over 11 hours. Comparison with the ISEE 3 magnetometer data indicates that these intervals nearly always occur in conjunction with large rotations of the interplanetary magnetic field. Statistical analyses of the plasma and magnetic field data for the 25 dropout intervals indicate that heat flux dropouts generally occur in association with high plasma densities low plasma velocities, low ion and electron temperatures, and low magnetic field magnitudes. A second set of 25 intervals chosen specifically to lie at large field rotations, but at times at which not heat flux dropouts were observed, do not show these characteristic plaisma variations. This suggests that the dropout intervals comprise a unique set of events. Since the hot halo electrons normally found streaming outward from the Sun along the interplanetary magnetic field (the solar wind electron heat flux) are a result of direct magnetic connection to the hot solar corona, heat flux dropout intervals may indicate that the spacecraft is sampling plasma regimes which are magnetically disconnected from the Sun and instead are connected to the outer heliosphere at both ends.

6402 Atmospheric Physics

39371 Large-scale resonant modification of the polar ionosphere by electromagnetic waves. Wong, A. Y. (Department of Physics, University of California, Los Angeles, California 90024-1547.(US)); Cheung, P. Y.; McCarrick, M. J.; Stanley, J.; Wuerker, R. F.; Close, R.; Bauer, B. S.; Fremouw, E.; Kruer, W.; Langdon, B.; and others. *Physical Review Letters (USA),* 63(3): 271-274 (17 Jul 1989).

Large-scale density modification was optimally achieved by electromagnetic waves whose frequency matched the plasma frequency at a height where the ionospheric density profile was flat. The density in this region was dramatically clamped during the morning when it normally increases from solar ionization. Electromagnetic wave propagation in the polar magnetic field geometry and strongly

resonantly enhanced electrostatic fields over a large region of constant density account for the observation.

6403 Atomic, Molecular, and Chemical Physics

Refer also to citation(s) 39082, 39621, 39632, 39645, 39674

39372 (CONF-890703–11) **Ion source studies at the ORNL ECR source facility.** Meyer, F.W.; Hale, J.W. Oak Ridge National Lab., TN (USA). 1989. 18p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From International conference on ion sources; Berkeley, CA, USA; 9-15 Jul 1989. Order Number DE89014881/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Using high resolution magnetic analysis, we have measured energy spreads of Ar^{+q} ($1 < q < 12$) ion beams extracted from the ORNL ECR ion source under a number of different ECR plasma conditions. The measured energy spreads for the different charge states fall in the range 8 to 20 eV per charge and are all roughly proportional to the ion charge. In addition, we have used a combination of magnetic and electrostatic analysis to investigate the high charge state tail of the extracted Ar^{+q} charge state distribution. Charge states up to +16 have been positively identified; in addition, tentative identification of extracted Ar^{+17} ions has been made, with total intensity in the range 10 to 20 kHz. 6 refs., 7 figs.

39373 (IAE–4711/3) **Design of a wide-pass-band system for focusing hard X radiation.** Arkadiev, V.A.; Fayazov, R.F.; Kumakhov, M.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1988. 45p. Order Number DE89630235/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The wide-pass-band X-ray optics principle potentialities has been analysed in terms of the geometric optics formalism. A wide-pass-band system for focusing hard X-ray radiation has been designed. The system allows achieving high levels of X-ray intensity in a small space region using ordinary X-ray sources. 23 refs.; 16 figs.; 8 tabs.

39374 (IAE–4742/1) **On the effect of Coulomb interaction on the multiphoton ionization probability.** Fomichev, S.V.; Zaretskij, D.F. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1988. 16p. Order Number DE89630204/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The nonresonant multiphoton ionization problem is considered in the case of one-dimensional Coulomb potential. The continuous spectrum wave function in the presence of electromagnetic field and Coulomb interaction is calculated in the quasiclassical approximation. The Coulomb interaction is taken into account by the use of the perturbation theory in that part of action which arises due to interaction with an electromagnetic field. Criteria of this approximation validity are found and it is shown that such an approach allows the process of nonresonant multiphoton ionization to be described in the field range $\epsilon << \epsilon_a$ (ϵ_a is the characteristic atomic field) for arbitrary values of the adiabaticity parameter γ. Within the range $\gamma >> 1$ the Coulomb factor in the ionization probability is independing of the field strength and has to be taken into account. 16 refs.

39375 (JINR-D–17-88-95, pp. 376-379) **Collective quantum beats in spontaneous emission from two nonidentical atoms.** Ficek, Z. (Uniwersytet Adama Mickiewicza, Poznan (Poland). Inst. Fizyki); Tanas, R.; Kielich, S. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. (CONF-8708341–: 4. International symposium on selected topics in statistical mechanics, Dubna, USSR, 25-29 Aug 1987). In *4. International symposium on selected topics in statistical mechanics.* Order Number DE89012150/JAW. Available from NTIS (US Sales Only), PC A21/MF A01; INIS.

The two-time second order correlation function for spontaneous emission from a fully inverted two-atom system is investigated. It is shown that quantum beats are present in the second-order correlation function of light radiated by a system of two identical as well as non-identical atoms. A master equation type of approach is used to derive the equations of motion for the atomic variables. 4 refs.; 3 figs.

39376 (KEK–88-5, pp. 45-53) **Detection of excited atoms and measurement of electron excitation coefficients for rare-gases by using near-infrared diode lasers.** Tachibana, Kunihide (Kyoto Inst. of Tech. (Japan)); Kitagawa, Norio; Harima, Hiroshi. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Jul 1988. (CONF-8802136–: 2. workshop on elementary-particle picture of the universe, Tsukuba, Japan, 4-6 Feb 1988). In *Radiation detectors and their uses.* Order Number DE89012160/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

A mechanism of self-quenching streamer (SQS) has recently been proposed in which the UV-photons emitted from excited rare-gas dimers have a significant contribution to the growth of SQS through the photoionization of premixed molecular gases. However, the whole mechanisms of the SQS growth probably include much more complicated processes, and it seems important to prepare various basic kinetic data for the establishment of a more realistic discharge model of the SQS. The present paper reports a sensitive absorption method for the detection of the lowest excited rare-gas atoms of Ar, Kr and Xe in the metastable and resonance levels, from which the excited dimers are produced by three-body collisions. Absorption line profiles are analyzed for the derivation of absolute number densities of excited atoms from absorption signals. Using the method in combination with the electron swarm technique, measurement is made of the excitation coefficients for these levels by collisions with electrons as a function of the ratio of electric field strength to gas density. Then, the excitation cross sections are derived from a comparison of measured excitation coefficients with calculations by Boltzman equation analysis. (N.K.).

39377 (KEK–88-5, pp. 54-63) **Penning ionization cross sections of excited rare gas atoms.** Ukai, Masatoshi (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)); Hatano, Yoshihiko. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Jul 1988. (CONF-8802136–: 2. workshop on elementary-particle picture of the universe, Tsukuba, Japan, 4-6 Feb 1988). In *Radiation detectors and their uses.* Order Number DE89012160/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

Electronic energy transfer processes involving excited rare gas atoms play one of the most important roles in ionized gas phenomena. Penning ionization is one of the well known electronic energy transfer processes and has been studied extensively both experimentally and theoretically. The present paper reports the deexcitation (Penning ionization) cross sections of metastable state helium $He(2^3S)$ and radiative $He(2^1P)$ atoms in collision with atoms and molecules, which have recently been obtained by the authors' group by using a pulse radiolysis method. Investigation is made of the selected deexcitation cross sections of $He(2^3S)$ by atoms and molecules in the thermal collisional energy region. Results indicate that the cross sections are strongly dependent on the target molecule. The deexcitation probability of $He(2^3S)$ per collision increases with the excess electronic energy of $He(2^3S)$ above the ionization potential of the target atom or molecule. Another investigation, made on the deexcitation of $He(2^1P)$, suggests that the deexcitation cross section for $He(2^1P)$ by Ar is determined mainly by the Penning ionization cross section due to a dipole-dipole interaction. Penning ionization due to the dipole-dipole interaction is also important for deexcitation of $He(2^1P)$ by the target molecules examined. (N.K.).

39378 (KEK–88-7, pp. 158-162) **Study on a volume-production H^- ion source.** Takama, S. (Kyoto Univ., Uji (Japan). Inst. for Chemical Research). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Oct 1988. (CONF-8804288–: Symposium on negative ion sources and their applications, Tsukuba, Japan, 5-6 Apr 1988). In *Proceedings of the symposium on negative ion sources and their applications.* Order Number DE89012159/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

H^- ions formed by volume-production are extracted from a multicuspion source. By applying a large positive bias to the plasma electrode, the ratio I_-/I_e becomes 1/20. H^- ion current of 0.4mA is extracted from a $0.3cm^2$ circular aperture at an arc current of 10A.

39379 (LA-UR–89-2231) **Theoretical atomic physics code development at Los Alamos.** Clark, R.E.H.; Abdallah, J. Jr. Los Alamos National Lab., NM (USA). 1989. 6p. Sponsored by DOE

Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890895–1: Polarization and correlation in electronic and atomic collisions, Hoboken, NJ, USA, 2-4 Aug 1989). Order Number DE89014467/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We have developed a set of computer codes for atomic physics calculations at Los Alamos. These codes can calculate a large variety of data with a minimum of effort on the part of the user. In particular, differential cross sections and electron impact coherence parameters can be readily obtained for arbitrary ions or atoms. Currently, the theory consists of non-relativistic Hartree-Fock structure calculations and non relativistic distorted wave approximation or first order many body theory collisional calculations. 12 refs., 2 figs., 5 tabs.

39380 (LBL–26404) **Conceptual design of a Gyrotron-driven superconducting ECR ion source.** Countryman, P.J.; Lyneis, C.M.; Wolgast, R.C. Lawrence Berkeley Lab., CA (USA). Mar 1989. 12p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890335–223: 13. particle accelerator conference, Chicago, IL, USA, 20-23 Mar 1989). Order Number DE89014883/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The conceptual design for a superconducting Electron Cyclotron Resonance Ion Source (ECRIS) is presented. It is designed to take advantage of frequency scaling in ECRIS and be driven at 28 GHz by a laboratory scale gyrotron. The superconducting coils are surrounded by a warm bore iron yoke. Possible applications include cyclotrons, heavy-ion synchrotrons, ion implantation in semiconductors, and experiments in atomic physics. 10 refs., 5 figs., 1 tab.

39381 Observation of Coulomb focusing of autoionization electrons produced in low-energy He^++He collisions. Swenson, J. K. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6372(US)); Havener, C. C.; Stolterfoht, N.; Sommer, K.; Meyer, F. W. *Physical Review Letters (USA),* 63(1): 35-38 (3 Jul 1989). DOE Contract AC05-84OR21400.

We report observation of a significant enhancement in the intensity of target and projectile autoionizing electrons produced in low-energy (2–15 keV) He^++He collisions. The target electron intensity is strongly peaked at 0° and confined to an angular range of ≈5° about the incident beam direction, while the projectile electron intensity shows a similar enhancement at 180°. We attribute this effect to *Coulomb focusing*, a new aspect of post-collision interaction which results from the deflection of the ejected electrons in the Coulomb field of the receding spectator ion.

39382 Accurate *ab initio* treatment of low-energy electron collisions with polyatomic molecules: Resonant electron-formaldehyde scattering. Rescigno, T. N. (Lawrence Livermore National Laboratory, P.O. Box 808, Livermore, California 94550(US)); McCurdy, C. W.; Schneider, B. I. *Physical Review Letters (USA),* 63(3): 248-251 (17 Jul 1989). DOE Contract W-7405-ENG-48;W-7405-ENG-36.

We report the first results of a fully *ab initio* treatment of the scattering of low-energy electrons by formaldehyde. The calculations are carried out using the complex Kohn variational method, which is an anomaly-free algebraic variational procedure, and are implemented by a combination of analytic and adaptive, three-dimensional quadrature techniques. The calculations reveal a low-energy shape resonance of $^2B_1$ symmetry, which is prominent in the elastic differential cross section only at large scattering angles, and which has been observed experimentally. Its position is sensitive to target distortion effects which are accurately handled by inclusion of an optical potential calculated from first principles.

39383 Three-body recombination of spin-polarized atomic hydrogen in very strong magnetic fields. Gillaspy, J. D. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138(US)); Silvera, I. F.; Brooks, J. S. *Physical Review [Section] B: Condensed Matter (USA),* 40(1): 210-223 (1 Jul 1989).

The study of spin-polarized atomic hydrogen in the three-dimensional gasphase has been extended into a new regime of magnetic field strength. Analysisof decay data for B=10–20 T reveal for the first time thecharacteristic peak in the three-body dipolar-decay rate constant as predictedby Kagan, Vartanyants, and Shlyapnikov (Zh. Eksp. Teor. Fiz.81, 1113 (1981) [Sov. Phys.—JETP 54, 590(1981)]). Beyond 17 T we observe a rapid falloff of thethree-body-decay rate constant. We also determine a value for thethree-body-exchange rate constant which is in accord with the calculation ofKagan *et al.* In contrast to the picture which was emerging fromprevious studies at more moderate fields, the data presented here suggest thatexisting theories are capable of describing the decay of the system in thevery-high-field limit. The new picture which is emerging suggests thatBose-Einstein condensation may be achievable at somewhat higher fields whichare currently available at high-magnetic-field facilities.

39384 Interference effects in electron-ion recombination. III. Excited target states and continuum-continuum coupling. LaGattuta, K. J. (Los Alamos National Laboratory, Mail Stop B-257, Los Alamos, New Mexico 87545 (US)). *Physical Review [Section] A: General Physics (USA),* 40(2): 558-566 (15 Jul 1989).

Provision is made for the existence of excited target states and projectile continuum-continuum coupling, within the framework of the interacting resonance theory of electron-ion recombination described previously [Phys. Rev. A 36, 4662 (1987); 38, 1820 (1988)]. This "extended" theory makes explicit what was merely implicit in these earlier works. Dielectronic recombination probabilities, which include the effects of interaction and interference between resonances, are derived for two model systems: (a) A target ground state supporting two coupled projectile continua, and one excited target state as a closed channel; (b) a ground and first excited target state, each supporting one projectile continuum, and a second excited target state as a closed channel. Explicit calculations are performed for model (b), wherein are included Rydberg series of fully interacting resonances built on each of the two excited target states. The probability of excitation from the ground to the first excited target state is also obtained for model (b). This probability includes the effect of the interaction and interference between resonances, as well as the interference between resonance and direct excitation processes.

39385 A Dirac-Fock-Slater approach to atomic structure for highly charged ions. Sampson, D. H. (Department of Astronomy, The Pennsylvania State University, University Park, Pennsylvania 16802 (US)); Zhang, H. L.; Mohanty, A. K.; Clark, R. E. H. *Physical Review [Section] A: General Physics (USA),* 40(2): 604-615 (15 Jul 1989). DOE Contract FG02-85ER53208.

A very rapid, but accurate, fully relativistic method for calculating the atomic-structure data needed in determining collision strengths for highly charged ions is developed. A more rapid quasirelativistic approximation to this approach is also described. Results for oscillator strengths and energies are compared with those by mostly more elaborate programs for neonlike and nickel-like ions and generally good agreement is obtained.

39386 Fully relativistic and quasirelativistic distorted-wave methods for calculating collision strengths for highly charged ions. Zhang, H. L. (Department of Astronomy, The Pennsylvania State University, University Park, Pennsylvania 16802 (US)); Sampson, D. H.; Mohanty, A. K. *Physical Review [Section] A: General Physics (USA),* 40(2): 616-632 (15 Jul 1989).

A rapid fully relativistic distorted-wave method for calculating collision strengths for highly charged ions is described. A more rapid quasirelativistic approximation in which the average over j value -1 is used for the relativistic quantum number κ for the free electrons is also discussed. Very rapid, but accurate, procedures for obtaining results for a given class of transitions for a large portion of an isoelectronic sequence by using fits to Z after making detailed calculations for only a few values of Z are described. Results by the present methods are compared with more elaborate relativistic distorted-wave calculations by other workers, principally for neonlike and nickel-like ions, but also comparisons for He-like, Li-like, and Na-like ions are discussed. In addition, comparisons with a few experimental results for neonlike barium could be made. Generally very good agreement is obtained with all these data.

39387 Electron-impact excitation of molecular ions. Neufeld, D. A. (Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, Massachusetts 02138 (US)); Dalgarno, A. *Physical Review [Section] A: General Physics (USA),* 40(2): 633-637 (15 Jul 1989).

A simple expression is derived that relates the rate coefficient for dipole-allowed electron-impact excitation of a molecular ion in the Coulomb-Born approximation to the Einstein *A* coefficient for the corresponding radiative decay. Results are given for several molecular ions of astrophysical interest. A general analytic expression is obtained for the equilibrium rotational level populations in the ground vibrational state of any molecular ion excited by collisions with electrons. The expression depends only upon the electron temperature, the electron density, and the rotational constant of the molecular ion. A similar expression is obtained for neutral polar molecules.

39388 Laser effects in photoionization: Numerical solution for a one-dimensional δ potential. LaGattuta, K. J. (Los Alamos National Laboratory, Mail Stop B-257, Los Alamos, New Mexico 87545 (US)). *Physical Review [Section] A: General Physics (USA)*, 40(2): 683-695 (15 Jul 1989).

The time-dependent Schrödinger equation was solved numerically, in one spatial dimension, for an electron bound initially ($t<0$) by a δ potential, and acted upon by a single-frequency classical electromagnetic field, turned on abruptly at $t=0$. The dipole approximation was invoked for the laser field, and magnetic interactions were ignored. Characteristic photoionization times were determined for a wide range of scaled laser intensities and scaled laser frequencies. The conditions under which well-defined quiver motion of the ionizing electron appears were clarified, and a spectrum of radiation emitted during the ionization process was determined. Above-threshold-ionization spectra of ionized electrons were also computed.

39389 Semiclassical formalism of optical absorption. Horovitz, B. (Department of Physics, Ben-Gurion University, Beer-Sheva 84105, Israel(US)); Bishop, A. R.; Phillpot, S. R. *Physical Review [Section] A: General Physics (USA)*, 40(3): 1240-1250 (1 Aug 1989). DOE Contract W-31-109-ENG-38.

A semiclassical formalism for the optical absorption in a coupled electron-ion system is developed. The formalism assumes (a) an initial periodic trajectory whose frequency is much lower than electronic energies, and (b) a short-memory condition, i.e., the excited-state trajectories diverge away from the initial one within one period. The result shows nonadiabatic features such as level broadening, sidebands, and tails in nonclassical regimes. The formalism is demonstrated on a model for polyacetylene and can account for unusual absorption data.

39390 Minimum-variance approach to electron-scattering calculations: Elimination of anomalies and Monte Carlo implementation. McCurdy, C. W. (Department of Chemistry, The Ohio State University, Columbus, Ohio 43210(US)); Rescigno, T. N. *Physical Review [Section] A: General Physics (USA)*, 40(3): 1297-1301 (1 Aug 1989). DOE Contract W-7405-ENG-36.

It is demonstrated, in calculations on one- and two-electron systems, that *K*-matrix (real-valued) boundary conditions in the trial wave function in the minimum-variance method can give anomalies at certain energies, while *T*-matrix (complex) boundary conditions do not. A Monte Carlo procedure is proposed for computing scattering amplitudes in a many-electron system that uses the minimum-variance approach to treat incident and target electrons on the same footing. Successful exploratory calculations on e^--H scattering in the radial limit suggest that this approach may provide a path to direct Monte Carlo scattering calculations on many-fermion systems.

39391 Orientation-dependent atomic model for electron transfer in ion-molecule collisions: Applications to H^++H_2 and He^{2+}+H_2. Shingal, R. (Department of Physics, Kansas State University, Manhattan, Kansas 66506(US)); Lin, C. D. *Physical Review [Section] A: General Physics (USA)*, 40(3): 1302-1309 (1 Aug 1989).

Single-electron-capture cross sections in collisions of protons and α particles with ground-state H_2 molecules have been studied for projectile energies in the range of 1–500 keV/amu. By treating the ground-state H_2 wave function as a linear combination of atomic orbitals from the two atoms, the electron-capture amplitude in ion-molecule collisions is expressed as the coherent superposition of two single-electron-capture amplitudes in *ion-atom* collisions with the relative phase between the two amplitudes dependent on the collision velocity and the orientation of the molecule. The dependence of the capture cross sections with respect to the molecular orientation was examined. Total electron-capture cross sections averaged over the molecular orientations were obtained and found to be in good agreement with experiments.

39392 Photodetachment spectra of H^- in parallel electric and magnetic fields. Du, M. L. (Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, Massachusetts 02138(US)). *Physical Review [Section] A: General Physics (USA)*, 40(3): 1330-1339 (1 Aug 1989).

Simple analytic formulas are presented for the photodetachment cross section of H^- in the presence of parallel electric and magnetic fields. A rich array of photodetachment spectra are displayed that illustrate the strong dependence of the cross section on the polarization of the photons and on the electric and magnetic fields.

39393 Relativistic theory for electron-ion scattering. Ritchie, B. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550(US)). *Physical Review [Section] A: General Physics (USA)*, 40(3): 1310-1314 (1 Aug 1989). DOE Contract W-7405-ENG-48.

A relativistic version of electron-scattering close-coupling theory (in the static approximation) is developed for the $1s_{1/2}$, $2s_{1/2}$, $2p_{1/2}$, and $2p_{3/2}$ states of hydrogenlike (or frozen-core, alkali-metal-like) target ions. Comparisons are made among close-coupling, distorted-wave, and semiclassical distorted-wave results as a function of scattering-electron energy and the charge of the target.

39394 Quantum reactive scattering via the *S*-matrix version of the Kohn variational principle: Differential and integral cross sections for D+H_2 →HD+H. Zhang, J. Z. H. (Department of Chemistry, University of California, and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720 (US)); Miller, W. H. *Journal of Chemical Physics (USA)*, 91(3): 1528-1547 (1 Aug 1989). DOE Contract AC03-76SF00098.

A comprehensive survey of the quantum scattering methodology that results from applying the *S*-matrix version of the Kohn variational principle to the reactive scattering formulation given by Miller [J. Chem. Phys. **50**, 407 (1969)] is presented. Results of calculations using this approach are reported for the reaction D+H_2 →HD+H. The 3-d calculations include total angular momentum values from $J=0$ up to 31 in order to obtain converged integral and differential cross sections over a wide range of energy (0.4–1.35 eV total energy). Results are given for reaction probabilities for individual values of *J*, integral and differential cross sections for a number of energies, and state-to-state rate constants (i.e., a Boltzmann average over translational energy), and comparisons are made to a variety of different experimental results. A particularly interesting qualitative feature which is observed in the calculations is that the *energydependence* of the differential cross section in the *backward direction* ($\theta=180°$) shows a resonance structure (due to a short-lived DH_2 collision complex) which is very similar to that in the $J=0$ reaction probability. This resonance structure does not appear in the energy dependence of the integral cross section, being averaged out by the sum over *J*.

39395 Electronic autoionization and vibrational-state distributions in resonant multiphoton ionization of H_2. Dixit, S. N. (Theoretical Atomic and Molecular Physics Group, Lawrence Livermore National Laboratory, L-446 Livermore, California 94550(US)); Lynch, D. L.; McKoy, B. V.; Hazi, A. U. *Physical Review [Section] A: General Physics (USA)*, 40(3): 1700-1703 (1 Aug 1989). DOE Contract W-7405-ENG-48;FG03-87ER60513.

We investigate the effects of electronic autoionization on the vibrationalbranching ratios in resonant multiphoton ionization of H_2.*Ab initio* calculations are performed to obtain the vibrational branchingratios for (3+1) resonant-enhanced multiphoton ionization (REMPI) ofH_2 via the $C\,^1\Pi_u$ state. Our calculationsinclude the effects of the dissociative$^1\Pi_g(1\sigma_u 1\pi_u)$ autoionizing state andproperly account for the interference between the direct and the indirect(autoionization) channels. We find that the direct and indirect amplitudes arecomparable for excitation via the higher ($v_i \geq 2$) vibrationallevels of the *C* state. Autoionization greatly enhances the branchingratios for $\Delta v \neq 0$ transitions. These calculations underscore thenecessity for a proper

treatment of both the direct and indirect contributionsin understanding the REMPI of molecules via autoionizing states.

39396 Point groups in the Vibron model. Leviatan, A. (Center for Theoretical Physics, Sloane Laboratory, Yale University, New Haven, Connecticut 06511 (US)). *Journal of Chemical Physics (USA)*, 91(3): 1706-1718 (1 Aug 1989).

The question of incorporating the notion of point groups in the algebraic Vibron model for molecular rotation–vibration spectra is addressed. Boson transformations which act on intrinsic states are identified as the algebraic analog of the discrete point group transformations. A prescription for assigning point group labels to states of the Vibron model is obtained. In case of nonlinear triatomic molecules the Jacobi coordinates are found to be a convenient possible choice for the geometric counterparts of the algebraic shape parameters. The work focuses on rigid diatomic and triatomic molecules (linear and bent).

39397 Rotationally resolved photoelectron angular distributions in resonance enhanced multiphoton ionization of NO. Rudolph, H. (Arthur Amos Noyes Laboratory of Chemical Physics, California Institute of Technology, Pasadena, California 91125(US)); McKoy, V. *Journal of Chemical Physics (USA)*, 91(4): 2235-2238 (15 Aug 1989).

We report calculated ionic rotational branching ratios and associated photoelectron angular distributions for (1+1′) resonance enhanced multiphoton ionization (REMPI) via the $R_{21}(20.5)$, $P_{21}+Q_{11}(25.5)$, and $P_{11}(22.5)$ branches of the $A\ ^2\Sigma^+(3s\sigma)$ state of NO. The branching ratios are dominated by even angular momentum transfer peaks, in agreement with the $\Delta N+l$=odd ($\Delta N \equiv N_+ - N_i$) selection rule. Whereas the calculated photoelectron angular distributions are very branch dependent alignment, the ionic branching ratios are found to be less so. The present calculated results agree well with the experimental results of Allendorf *et al.*

39398 The collapse transition of self-avoiding walks on a square lattice: A computer simulation study. Meirovitch, H. (Supercomputer Computations Research Institute, Florida State University, Tallahassee, Florida 32306-4052(US)); Lim, H. A. *Journal of Chemical Physics (USA)*, 91(4): 2544-2554 (15 Aug 1989).

Employing the scanning simulation method, we study the tricritical behavior (at the Flory θ point) of self-avoiding walks with nearest-neighbors attraction energy $\epsilon(-|\epsilon|)$ on a square lattice. We obtain $-\epsilon/k_BT_t$=0.658±0.004, where T_t is the tricritical temperature and k_B is the Boltzmann constant. The radius of gyration G and the end-to-end distance R lead to $\nu_t(G)$=0.5795±0.0030 and $\nu_t(R)$ =0.574±0.006, respectively. We also obtain γ_t=1.11±0.022 and μ_t =3.213±0.013, where γ_t is the free energy exponent and μ_t is the growth parameter. Three estimates are calculated for the crossover exponent ϕ_t , based, respectively, on G, R and the specific heat C: ϕ_t (G)=0.597±0.008, $\phi_t(R)$=0.564±0.009, and $\phi_t(C)$=0.66±0.02. Our values for ν_t and γ_t are close to the Duplantier and Saleur exact values for the θ' point, ν_t =4/7=0.571... and γ_t=8/7=1.142 ... . However, our values of ϕ_t are significantly larger than the exact value ϕ_t=3/7=0.42... . This suggests that the θ and θ' points belong to different universality classes.

39399 Aerodynamic focusing of heavy molecules in seeded supersonic jets. Fernandez de la Mora, J. (Yale University, Department of Mechanical Engineering, New Haven, Connecticut 06520(US)); Rosell-Llompart, J. *Journal of Chemical Physics (USA)*, 91(4): 2603-2615 (15 Aug 1989).

The phenomenon of aerodynamic enrichment of heavy molecules seeded in supersonic free jets has been known since 1955. But its systematic exploitation in the generation of intensely focused molecular beams has been prevented by the lack of a quantitative and realistic explanation of the observed facts. Here, the aerodynamic focusing of CBr_4, $W(CO)_6$, and C_2Cl_6 molecules seeded in jets of He or H_2 is studied experimentally, and found to be most singular under conditions similar to those known to produce sharply focused beams of microscopic spheres suspended in air jets. The gas mixture expands through thin-plate orifice into a vacuum chamber, forming a supersonic free jet. The spacial distribution of the heavy molecules in the jet is measured at varying distances L to the nozzle by scanning a thermocouple probe across a jet diameter. The probe is sufficiently small to interfere negligibly with the flow. The increment DV in the thermocouple voltage resulting from seeding the heavy gas on a given flow of He or H_2 is seen to be a sensitive indicator of the local concentration of seed molecules in the jet. The following behavior is observed in terms of the same Stokes number or inertia parameter S that governs the simpler and better understood phenomenon of aerosol focusing. Below S=0.4 for H_2 and S=0.2 for He, heavy molecule and aerosol beam widths are practically identical, and the boundary of the jet of heavy molecules is rather sharp. At higher values of S, aerosol beams show further reductions

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39400 (EUR–11705, pp. 177-182) **Bootstrap current in stellarator configurations in the long mean free path regime.** Harmeyer, E. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)); Kisslinger, J.; Montvai, A.; Rau, F.; Wobig, H. Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

The boostrap current is a direct consequence of the neoclassical properties of the transport in toroidal confinement systems. Because of this there should be a strong correlation between the velocity of the neoclassical drift, and the expected total diffusion driven current. In this paper it is shown, that the above statement is only partially true. The direct coupling of the parallel current and the radial drift is valid only under certain circumstances. In the limiting case of the completely collisionless plasma it is trivially violated. This follows from the fact, that the anisotropy part of the pressure tensor is determined by a complicated interaction of the actual geometry of the magnetic surface and the collision frequency. Nevertheless the theory of the diffusion driven current developed by Shaing and others is sufficiently selective in the sense, that vanishing value of the geometrical factor therein means a very low total current value to be expected. Finally a comparison is given among several nonsymmetric configurations based on the geometrical factor mentioned.

39401 (JINR-D–17-88-95, pp. 88-94) **Magnetic type charge (monopole) for superfluid velocity in ^{3}He-A and ^{3}He-B.** Galasiewicz, Z.M. (Wroclaw Univ. (Poland). Inst. Fizyki Teoretycznej). Joint Inst. for Nuclear Research, Dubna (USSR). 1988. (CONF-8708341–: 4. International symposium on selected topics in statistical mechanics, Dubna, USSR, 25-29 Aug 1987). In *4. International symposium on selected topics in statistical mechanics.* Order Number DE89012150/JAW. Available from NTIS (US Sales Only), PC A21/MF A01; INIS.

Magnetic type charge (monopole) is defined for superfluid velocity in ^{3}He-A and ^{3}He-B. For the A-phase the rotation symmetry in a spin space is shown to be broken because of a prederred direction described by the unit vector d. For the B-phase the rotation matrix describing the rotation of the spin systme is considered. The extra eqautions of motion were derived from the overaged equations of motion for the components of the operator T. 8 refs.

39402 (JINR-D–17-88-95, pp. 194-201) **Stability of phase diagram of liquid ^{3}He.** Capel, H.W. (Amsterdam Univ. (Netherlands). Inst. voor Theoretische Fysica). Joint Inst. for Nuclear Research, Dubna (USSR). 1988. (CONF-8708341–: 4. International symposium on selected topics in statistical mechanics, Dubna, USSR, 25-29 Aug 1987). In *4. International symposium on selected topics in statistical mechanics.* Order Number DE89012150/JAW. Available from NTIS (US Sales Only), PC A21/MF A01; INIS.

The stability of the phase diagram of liquid ^{3}He is discussed in the weak-coupling approximation under the influence of a small Hubbard term. The Hubbard term described hard core effects and short-range Coulomb repulsions which are not properly taken into account in H_{BCS} (H_{BCS}-hamiltonian of liquid ^{3}He in the weak-coupling approximation). The Landau expansion in terms of the 9 complex order parameters and its coefficients is presented. The stability of the phase diagram under a small perturbation H_1 is treated

and discussed in relation to the situation for liquid ^{3}He. 21 refs.; 2 figs.

39403 (JINR-D–17-88-95, pp. 228-235) **Theory of superfluid Fermi liquid.** Krasil'nikov, V.V. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.); Peletminskij, S.V.; Rozhkov, A.A.; Yatsenko, A.A. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. (In Russian). (CONF-8708341–: 4. International symposium on selected topics in statistical mechanics, Dubna, USSR, 25-29 Aug 1987). In *4. International symposium on selected topics in statistical mechanics.* Order Number DE89012150/JAW. Available from NTIS (US Sales Only), PC A21/MF A01; INIS.

Phenomenological of superfluid Fermi liquid on a common base is developed when Fermi liquid amplitudes are equally accounted for both in normal and superfluid state. In this case the superfluid Fermi liquid energy E is assigned as the functional of normal and anomalous distribution functions which are combined into a certain supermatrix f. Energy functional E(f-circumflex) symmetry properties sufficiently used in the whole Fermi liquid approach to superfluidity theory are studied. An expression for entropy as the functional of normal and anomalous fermion distribution functions, generalizing combinatorial entropy expression for Fremi gas are found. Extreme entropy principle leads to a self-consistent equation for equilibrium supermatrix F-circumflex, generalysing ordinary equations of BCS-Bogolyubov theory and transferring into the latter in case of a weak Fermi liquid interaction. Equilibrium fluxes of additive motion integrals in terms of equilibrium thermodynamic potential are found. Ideal hydrodynamics of superfluid Fermi liquid is constructed without the assumption concerning Galilean invariance of the system. 7 refs.

39404 (SAND–89-1237C) **Accurate Navier-Stokes results for the hypersonic flow over a spherical nosetip.** Blottner, F.G. Sandia National Labs., Albuquerque, NM (USA). 1989. 12p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8906134–2: 24. AIAA thermophysics conference, Buffalo, NY, USA, 11-15 Jun 1989). Order Number DE89013580/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The unsteady thin-layer Navier-Stokes equations for a perfect gas are solved with a linearized block Alternating Direction Implicit finite-difference solution procedure. Solution errors due to numerical dissipation added to the governing equations are evaluated. Errors in the numerical predictions on three different grids are determined where Richardson extrapolation is used to estimate the exact solution. Accurate computational results are tabulated for the hypersonic laminar flow over a spherical body which can be used as a benchmark test case. Predictions obtained from the code are in good agreement with inviscid numerical results and experimental data. 9 refs., 11 figs., 3 tabs.

39405 (UCRL–100586) **Multistage gasdynamic launchers.** Glenn, L.A.; Latter, A.L.; Martinelli, E.A. Lawrence Livermore National Lab., CA (USA). 1 May 1989. 18p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890812–1: American Physical Society topical conference on shock compression of condensed matter, Albuquerque, NM, USA, 14-17 Aug 1989). Order Number DE89011633/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The maximum velocity attainable in a gasdynamic gun is limited by the maximum sound speed in the driver gas. For a conventional 2-stage light gas gun, the limit is ~10 km/s. Higher velocities are possible in a 2-stage system, but only by employing barrels of an impractical length, to keep the pressure low, or by allowing such high pressure in the barrel and on the projectile that either or both are shattered or vaporized. By using a multi-stage design, the peak pressure can be limited in each stage to an acceptable level, with an acceptable barrel length, while the gas temperature, and hence the sound speed, is increased as necessary. A simple analytical model of such a device has been constructed to identify design constraints and predict performance. The results are in good agreement with more complicated numerical models when 2D effects are small and a γ-law driver gas is used. Numerical simulations that include estimates of 2D effects, pressure gradients in the gas, and more realistic constitutive models, indicate that projectile velocities up to 20 km/s may be achieved without projectile break-up, with satisfactory barrel lengths, and with peak pressures between 8–13 GPa. Whether higher pressures are possible remains to be investigated. The major contributors to projectile break-up are excessive heating on compression, barrel drag, and especially excessive release rate on decompression. 5 refs., 7 figs.

39406 Evolution of a lamellar system with diffusion and reaction: A scaling approach. Muzzio, F. J. (Department of Chemical Engineering, University of Massachusetts, Amherst, Massachusetts 01003(US)); Ottino, J. M. *Physical Review Letters (USA),* 63(1): 47-50 (3 Jul 1989).

We study, by means of computer simulation and scaling analysis, the time evolution of one-dimensional arrays of reactive lamellae described by various initial striation thickness distributions. An infinitely fast reaction $A+B\rightarrow 2P$ occurs at the junctures of the lamellae. As the reaction proceeds thin striations are eaten by thick neighboring striations altering the distribution. The system converges toward a universal striation thickness distribution.

39407 Charged-particle interaction with liquids: Ripplon excitations. Barberan, N. (Departamento de Estructura y Constituyentes de la Materia, Facultad de Fisica, Universidad de Barcelona, Diagonal 647, E-08028 Barcelona, Spain(ES)); Garcia-Molina, R.; Gras-Marti, A. *Physical Review [Section] B: Condensed Matter (USA),* 40(1): 10-19 (1 Jul 1989).

We calculate the ripplon field contribution to the self-energy of an electron exterior to a liquid for planar and spherical geometries. We comparethe full dielectric calculation of the electron-liquid interaction with thesimpler alternative method consisting of integrating the electron-atomstatic-induced-dipolar potential through the whole liquid volume. We obtaingood agreement between both methods for a nonpolar liquid such as^{4}He but differences up to 40% for a polar liquid such as water.We study the conditions under which the ripplon contribution to the self-energyis a perturbation. For an electron moving parallel to a planar liquid surface,we calculate the ripplon contribution to its stopping power. For this dynamicalcase, we conclude that the alternative method is a good approximation even forpolar liquids.

39408 Local adaptive mesh refinement for shock hydrodynamics. Berger, M. J. (Courant Institute of Mathematical Sciences, New York University, 251 Mercer Street, New York, 10012 New York(US)); Colella, P. *Journal of Computational Physics (USA),* 82(1): 64-84 (May 1989).

The aim of this work is the development of an automatic, adaptive mesh refinement strategy for solving hyperbolic conservation laws in two dimensions. There are two main difficulties in doing this. The first problem is due to the presence of discontinuities in the solution and the effect on them of discontinuities in the mesh. The second problem is how to organize the algorithm to minimize memory and CPU overhead. This is an important consideration and will continue to be important as more sophisticated algorithms that use data structures other than arrays are developed for use on vector and parallel computers. © 1989 Academic Press, Inc.

39409 Incorporation and test of diffusion and strain effects in the two-dimensional vortex blob technique. Meiburg, E. (Department of Chemical Engineering, Stanford University, Stanford, California 94305(US)). *Journal of Computational Physics (USA),* 82(1): 85-93 (May 1989).

Vorticity diffusion as well as small scale strain effects in a rotational fluid layer are incorporated in the vortex blob technique by changing the blob size. While the strain effect is computed by approximately the derivative of the normal velocity component across the layer, the vorticity diffusion is accounted for on the basis of the similarity solution for a diffusively spreading vortex sheet. This approach, which presents an alternative to the random walk method, allows us to track vorticity fronts in flows that do not conserve circulation such as miscible multiphase Hele-Shaw flows. We test the numerical method by comparing numerically obtained linear growth rates for an inviscid parallel shear layer and a miscible displacement process in a porous medium to exact results obtained from linear stability theory. When compared to the constant size vortex blob technique, the present extensions yield greatly improved results for the inviscid shear layer. For the diffusively spreading rotational layer arising in the miscible displacement process, the

numerically obtained time-dependent growth rates show good quantitative agreement with exact results. © 1989 Academic Press, Inc.

39410 Variational calculations of drops of spin-polarized liquid ^{3}He. Lewart, D. S. (Department of Physics and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801(US)); Pandharipande, V. R.; Pieper, S. C. *Physical Review [Section] B: Condensed Matter (USA),* 40(1): 712-714 (1 Jul 1989). DOE Contract W-31-109-ENG-38.

The ground states of drops of spin-polarized liquid ^{3}Hecontaining 56, 84, and 120 atoms are calculated with the variational Monte-Carlo method using wave functions containing pair, triplet, and backflowcorrelations. The calculated energies of these drops are higher by ~0.2K per atom than those of drops of unpolarized liquid ^{3}He. Theresults also indicate that the equilibrium density of liquid^{3}He$_\uparrow$ is larger than that of unpolarized^{3}He by ~5%, and that the thickness of its surface issmaller.

39411 Cellular-automaton simulations of simple boundary-layer problems. Lim, H. A. (Supercomputer Computations Research Institute, The Florida State University, Tallahassee, Florida 32306-4052 (US)). *Physical Review [Section] A: General Physics (USA),* 40(2): 968-980 (15 Jul 1989).

A lattice-gas automaton is a variant of a cellular automaton. Its cellularuniverse is a regular triangular lattice, and particles reside on the latticenodes. The time evolution of this discrete dynamical system of particlesproceeds in two alternating phases: collision and propagation. Such a model,though very simple and deterministic, is capable of producing very complexbehaviors. A boundary layer develops whenever a real, viscous fluid flows alonga solid boundary. We simulate boundary-layer and related problems in theincompressible limit of fluid dynamics using a lattice-gas automaton. Ourlattice-gas automaton simulations show that viscosity effects on Couette flows(flows between parallel plates), Stokes flows, and Blasius flows (flows acrossa plate) give results as predicted by the Navier-Stokes equations. Byconsidering different geometries and by carefully varying the gas properties,we obtain in particular the time-dependent velocity profiles, which are in goodagreement with theoretical predictions. These inferences may be viewed asfurther support for the internal consistency of the lattice-gas approach, andthey also substantiate the belief that the lattice-gas automaton can be auseful, viable tool for simulating fluid dynamics.

39412 A theory of abrupt termination and spontaneous restart of electrical current in surface flashover arcs. Kadish, A. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545(US)); Robiscoe, R. T.; Maier II, W. B. *Journal of Applied Physics (USA),* 66(4): 1579-1593 (15 Aug 1989).

The space-time dynamics of surface flashover discharges is studied using a nonlinear one-dimensional transmission line model. When the current I is not zero, the relation between the resistance per unit length, R', and I is assumed to be given by a local arc welder's ansatz, $R'|I|=E'$, where E' is a constant. The model predicts a threshold for discharge, and abrupt local termination and spontaneous restart of the discharge current. If at a place on the discharge path it happens that the charge gradient fails to exceed the threshold condition when the current vanishes, then the current will abruptly terminate there. However, if a discharge current flows in a region adjacent to one where the current has terminated, the edge of the current-free region can be "ignited," resulting in the "active" region encroaching on the "quiet" one. A formula for the speed of encroachment is derived. Formulas are also derived for current pulse waveforms and the charge transported during the discharge.

39413 Helical, dissipative, magnetohydrodynamic states with flow. Montgomery, D. (Department of Physics and Astronomy, Dartmouth College, Hanover, New Hampshire 03755(US)); Phillips, L.; Theobald, M. L. *Physical Review [Section] A: General Physics (USA),* 40(3): 1515-1523 (1 Aug 1989).

It is shown that for an axially periodic column of magnetofluid driven by an applied axial electric field, the total rate of energy dissipation (Ohmic plus viscous) can be lowered by permitting a helical component with vortical flow in the solution. The principle of minimum energy-dissipation rate suggests that this partially helical state will be preferred to the axisymmetric one that exists for the same parameters. The result is consistent with the repeated appearance of such partially-helical states in several fully three-dimensional numerical computations and is not inconsistent with the data from some confinement experiments.

39414 Theory of applied-B ion diodes. Desjarlais, M. P. (Sandia National Laboratories, Albuquerque, New Mexico 87185(US)). *Physics of Fluids B: Plasma Physics (USA),* 1(8): 1709-1720 (Aug 1989). DOE Contract AC04-76DP00789.

A recently introduced theory of applied-B ion diodes [Phys. Rev. Lett. **59**, 2295 (1987)] is developed and presented in detail. The theory incorporates the self-consistent virtual cathode motion to obtain the steady-state ion current as a function of diode voltage. The existence of a limiting voltage at which the ion current diverges is demonstrated. The voltage–current characteristics of the diode are combined with a simple circuit model of the accelerator to calculate the operating point of the diode. The theoretical results are in good agreement with experimental data at peak power. An important consequence of the theory is a relation between the limiting diode voltage and the insulating magnetic flux, suggesting a late-time voltage decay driven by flux penetration into the anode plasma.

39415 Gasdynamic focusing in an underexpanded jet. Muenchausen, R. N. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545(US)); Garcia, A. R.; Keller, R. A.; Nogar, N. S. *Applied Optics (USA),* 28(15): 3220-3225 (1 Aug 1989).

Gasdynamic focusing is demonstrated to concentrate a sample stream along the flow axis in an underexpanded supersonic jet. The focusing is characterized, using the technique of laser-induced fluorescence, for an I_2 seeded He expansion at pressure ratios between 2 and 6. The spatial fluorescence profile is monitored via array detection as a function of the sample and sheath volume flow rates and pressures. For source pressures between 10 and 100 Torr, the results obtained can be qualitatively understood using the model of hydrodynamic focusing. The observed deviations from this model are discussed in terms of gaseous diffusion and jet expansion.

6451 Particle Interactions and Properties - Experimental

Refer also to citation(s) 39446, 39473, 39495, 39542

39416 (ANL-HEP-CP–89-49) **Direct photon experiment at POLEX.** Ohashi, Y. Argonne National Lab., IL (USA). High Energy Physics Div. 1989. 8p. Sponsored by DOE Energy Research. DOE Contract W-31109-ENG-38. (CONF-8903137–1: Workshop on physics at UNK, Protvino, USSR, 20-25 Mar 1989). Order Number DE89014673/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Significant contribution of the gluons to the proton spin has been suggested by several authors to explain the recent EMC results on the spin dependent structure function of proton. Direct photon measurements at large transverse momentum in pp reactions with pure initial helicity states is proposed in this paper in order to study spin dependent gluon structure function. 8 refs., 3 figs., 1 tab.

39417 (BNL–42925) **Brookhaven experiment 787: The search for $K^+ \to \pi^+\nu\bar{\nu}$.** Meyers, P.D. Princeton Univ., NJ (USA). Dept. of Physics. 1989. 11p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8903132–8: 24. Rencontres de Moriond: electroweak interactions and unified theories, Les Arcs, France, 5-12 Mar 1989). Order Number DE89015095/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A description is presented of E-787's rare K decay spectrometer and the search for the rare decay $K^+ \to \pi^+\nu\bar{\nu}$, expected in the Standard Model to have a branching ratio of $(1 - 8) \times 10^{-10}$. Preliminary results are presented from the 1988 run of E-787. We are able to set the 90% confidence level upper limits: $BR(K^+ \to \pi^+ \nu\bar{\nu}) < 3 \times 10^{-8}$, $BR(K^+ \to \pi^+ f) < 6 \times 10^{-9}$, $BR(K^+ \to \pi^+\mu^+\mu^-) < 2.1 \times 10^{-7}$, $BR(K^+ \to \pi^+ H) \times BR(H \to \mu^+\mu^-) < 1.5 \times 10^{-7}$, $BR(\pi^0 \to \nu\bar{\nu}) < 8 \times 10^{-7}$, where f is any massless, neutral, weakly interacting particle and H is a Higgs boson with $2m_\mu < m_H < 320$ MeV/c^2. Further running is in process and we hope to accumulate an approximately ten times larger data sample in 1989. 15 refs., 4 figs., 3 tabs.

39418 (FNAL/C–89/117-E) **Jet energy measurement CDF experience.** Huth, J. Fermi National Accelerator Lab., Batavia, IL (USA). Mar 1989. 32p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-890379–10: Workshop on calorimetry for the SSC, Tuscaloosa, AL (USA), 13-17 Mar 1989). Order Number DE89014862/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper outlines CDF experience with jet energy measurements, with an emphasis on the systematic uncertainties. The systematics can be broadly classified as the low energy response (e/h) fragmentation, clustering effects, the detector simulation, calibration and the underlying event. In addition, for specific measurements, like the inclusive E_t distribution, the existence of a steeply falling spectrum, convolved with a wide resolution function can give a distorted result. Resolution, therefore will also be discussed. 10 refs., 21 figs.

39419 (INIS-mf–11468) **Deeply bound orbits in pionic atoms and the optical potential.** Taal, A. Technische Univ. Delft (Netherlands). 21 Mar 1989. 107p. Order Number DE89630675/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

Includes summary in Dutch.

This thesis is concerned with the study of the pion-nucleus interaction by means of the measurement and analysis of X-ray transitions in pionic atoms. The 3d-level shifts and widths ^{93}Nb, sup (nat)Ru, sup (nat)Ag and sup (nat)Cd have been measured. Also measurements of other deeply bound pionic orbits have been performed on pionic atoms with the nuclei ^{24}Mg, ^{27}Al and ^{28}Si (1s-levels), ^{93}Nb and sup (nat)Ru (2p-levels). The pionic 1s-level measurements were of special interest since it has been shown that the earlier observed deviations for deeply bound 3d-states could be caused by an enhanced s-wave repulsion. It was found, however, that the pionic 1s-level shifts were not anomalous. The 2p-level shifts of ^{93}Nb and sup (nat)Ru were found to be negative as predicted from the strong attractive pionic p-wave interaction to be dominated by the repulsive s-wave in the region of Z=36. For the pionic 2p -> 1S X-ray transition in the isotopes ^{24}Mg, ^{27}Al and ^{28}Si, the yield was rather low due to the large absorption probability in the higher orbits. In order to measure these transitions in a way suitable for a reliable analysis special modern spectroscopic techniques, for improving peak to background ratios, discrimination against certain pion absorption channels and suppressing the influence of neutrons resulted in reliable measurements. A significantly good reproduction of both the deviating 3d-level shifts and widths could be isovector terms. In the region of Z>67 the influence of the pionic s-wave interaction term in the optical potential is analogous way as in the 2p-levels for high Z. A new fit of the optical potential parameters has resulted in an improved matching of the calculated shifts and widths with the experimental values for all pionic levels. (H.W.). 87 refs.; 31 figs.; 25 tabs.

39420 (INIS-mf–11469) **Neutral strange particle production in π^+/K+p interactions at 250 GeV/c.** Scholten, A.J. Katholieke Univ. Nijmegen (Netherlands). 1 Nov 1988. 108p. Order Number DE89630676/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

Includes summary in Dutch.

This thesis in which a detailed study of K^n inclusive production in K^+p and π^+p interactions at 250 GeV/c is presented, concentrates on neutral strange interaction products and draws some conclusions about the fate of the strange quark. In ch. 2 the experimental setup is described and in ch. 3 the series of computer programs that perform data reduction. Ch. 4 deals with the selectionn of events and neutral kaons. Also the calculations needed to correct for losses and background are described there. In ch. 5 inclusive and semi-inclusive distributions are presented and compared to data obtained in experiments at lower beam energy. In ch. 6 the data are compared with model predictions. In ch. 7 the main conclusions are summarized. (H.W.). 64 refs.; 39 refs.; 19 tabs.

39421 (JINR-R–1-88-617) **Study on neutron interactions with protons and carbon nuclei at p=4.2 GeV/c.** Bekmirzaev, R.N.; Muminov, M.M.; Sultanov, M.U.; Grishina, O.V.; Dolejsi, J.; Tas, P.; Trka, Z. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy. 1988. 7p. (In Russian). Order Number DE89630677/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The production of neutrons with p=4.2 GeV/c in d(C_3H_8) collisions and their interaction with proton and carbon nuclei are studied. The experimental material has been obtained using the 2m propane bubble chamber irradiated by deuterons with p=4.2 GeV/c per nucleon at the Dubna synchrophasotron, JINR. The data on multiplicity and momentum characteristics of secondary particles in np and nC interactions compared with the calculations on the LUND model are obtained. 6 refs.; 4 tabs.

39422 (LAPP-TH–209-88) **On the production of low-mass lepton pairs at large transverse momentum.** Aurenche, P.; Baier, R.; Fontannaz, M. Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules. Mar 1988. 8p. Order Number DE89791989/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

We relate the cross section for the production of low-mass lepton (Drell-Yan) pairs at large transverse momentum to the inclusive prompt (real) photon spectrum. The later one is then evaluated at second order in the QCD coupling constant α_s; predictions are obtained using next-to-leading order quark/gluon densities. Finally, a quantitative comparison with the recent pair data of the UA1 Collaboration is successfully performed. Therefore the considered process is conjectured as an extremely useful probe of the proton structure at small values of x.

39423 (LA-UR–89-1966) **Neutrino physics at LAMPF.** Garvey, G.T. Los Alamos National Lab., NM (USA). 1989. 14p. Sponsored by DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-8906160–1: Yamada conference on nuclear weak process and nuclear structure, Osaka, Japan, 12-15 Jun 1989). Order Number DE89014256/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

There are three neutrino experiments at LAMPF in various stages of completion or development. E225, the study of electron-neutrino electron scattering, which completed data taking in December 1986 and has just about completed all its analysis. E645, a search for $\bar{\nu}_\mu \rightarrow \bar{\nu}_e$ oscillation, is in its third and final year of data taking. The Large Cerenkov Detector (LCD), associated with E1015, has undergone extensive scientific and technical review and we are presently trying to obtain the necessary funds to build the detector, beam line, and target. In the following, each of these experiments will be briefly discussed. Before doing so, it is useful to show the characteristics of the neutrino spectrum resulting from the decay of π^+ at rest. It is also useful to realize that, on average, an 800-MeV proton from LAMPF produces about 0.1 π^+ decaying at rest. 16 refs., 5 figs., 4 tabs.

39424 (LA-UR–89-2010) **Improved limit on the mass of ν_e from the beta decay of molecular tritium.** Bowles, T.J.; Friar, J.L.; Robertson, R.G.H.; Stephenson, G.J. Jr.; Wark, D.L.; Wilkerson, J.F.; Knapp, D.A. Los Alamos National Lab., NM (USA). 1989. 14p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-8906160–2: Yamada conference on nuclear weak process and nuclear structure, Osaka, Japan, 12-15 Jun 1989). Order Number DE89014035/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We report a new upper limit of 13.4 eV (95% confidence level) on the mass of the electron antineutrino from a study of the shape of the beta spectrum of free molecular tritium. This result appears to be inconsistent with a reported value for the mass of 26(5) eV. The electron neutrino is evidently not massive enough to close the universe by itself. 23 refs., 1 fig., 2 tabs.

39425 (MPI-PAE/Exp.El.–199) **Experimental test of the PCAC hypothesis in the reactions $\nu_\mu p \rightarrow \mu^- p \pi^+$ and anti $\nu_\mu p \rightarrow \mu^+ p \pi^-$ in the $\Delta(1232)$ region.** Jones, G.T.; Jones, R.W.L.; Kennedy, B.W.; O'Neale, S.W.; Morrison, D.R.O.; Mobayyen, M.M.; Wainstein, S.; Aderholz, M.; Hantke, D.; Hoffmann, E.; Birmingham-CERN-Imperial College-Muenchen (MPI)-Oxford-University College Collaboration (WA21). Birmingham-CERN-Imperial College-Muenchen (MPI)-Oxford-University College Collaboration (WA21). Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik. Apr 1989. 30p.

Available from Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik.

Data on the reactions $\nu_\mu p \rightarrow \mu^- p \pi^+$ and anti $\nu_\mu p \rightarrow \mu^+ p \pi^-$ in the $\Delta(1232)$ region are presented and a test of the PCAC hypothesis, using a modified version of the Adler model, is performed. The analysis is based on 1081 events in the neutrino and on 180 events in the antineutrino reaction, obtained in a bubble chamber experiment with BEBC at CERN. The experimental cross-sections for an invariant hadronic mass $W<1.4$ GeV and an (anti-)neutrino energy $E_\nu{}^L>10$ GeV are determined to be $(0.628\pm0.059)\times10^{-38}$ cm^2 for the neutrino and $(0.168\pm0.023)\times10^{-38}$ cm^2 for the antineutrino reaction. The Q^2 and W distributions, the density matrix elements of the Δ resonance, and moments of the pion angular distribution are discussed. The data are found to be in good agreement with the Adler model in the Q^2 region below 1 GeV^2. A maximum likelihood fit for the axial mass m_A in the axial-vector form factor yields a value of $m_A=1.31\pm0.12$ GeV. At low Q^2 the data confirm the PCAC hypothesis and the discrepancy, formerly observed between the experimental and theoretical cross-sections for $\nu_\mu p \rightarrow \mu^- p \pi^+$ at low momentum transfer ($Q^2<$ or approx.0.2 GeV^2), is understood as being due to inadequate pion 'off-mass-shell' corrections. (orig.).

39426 (SLAC–345) **Hadronic decays of the D_s meson.** Wasserbaech, S.R. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jun 1989. 120p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00515. Order Number DE89014397/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The $D_s{}^+$ is the lowest-lying pseudoscalar meson containing charm and anti-strange quarks. Evidence for this state was first reported in 1977, although more recent observations disagree with some of the early results. Since 1983 the weakly decaying $D_s{}^+$ has been observed in many experiments. Relative branching fractions have been measured for many non-leptonic decay modes, including $D_s{}^+ \rightarrow \phi\pi^+$, $\phi\pi^+\pi^+\pi^-$, $\bar{K}^{*0}K^+$, and $f_0(975)\pi^+$. The absolute branching fractions are estimated in high energy e^+e^- annihilation from the observed numbers of reconstructed $D_s{}^+$ decays and the expected $D_s{}^+$ production cross section. The lowest-lying vector $c\bar{s}$ meson, the $D_s{}^{*+}$, has also been seen in its decay to $\gamma D_s{}^+$. Weak decays of the heavy quark and lepton flavors are relevant to the development of the Standard Model of both the electroweak and the strong interactions. Measurements of charmed particle weak decay are useful for determining the parameter of the Standard Model and for testing phenomenological models which include strong effects. 83 refs., 56 figs., 12 tabs.

39427 (SLAC-PUB–4971) **The Tau-Charm Factory and tau physics.** Perl, M.L. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Apr 1989. 11p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8902122–2: Results and perspectives in particle physics, LaThuile (Italy), 26 Feb - 4 mar 1989). Order Number DE89013891/JAW. Available from NTIS, PC A02/MF A01 - OSTI.

An international group of physicists is developing the concept and design of a Tau-Charm Factory: a two-ring, electron-positron, circular collider with $1.5 <= \sqrt{s} <= 4.2$ GeV and a design luminosity of 10^{33} cm^{-2} s^{-1}. This paper presents the concept of the facility and outlines the tau lepton physics which can be done. A companion talk by R. Schindler discusses the D^0, $D^\pm$, and D_s physics at a Tau-Charm Factory. 25 refs., 2 tabs.

39428 (SLAC-PUB–4992) **Prospects in K physics.** Gilman, F.J. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jun 1989. 21p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8905183–1: Workshop on physics at the main injector, Batavia, IL, USA, 16-18 May 1989). Order Number DE89013893/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Prospects for future experiments involving rare K decays are reviewed. 26 refs., 8 figs.

39429 (SLAC-PUB–4995) **Charmed meson physics accessible to an $L = 10^{33}$ cm^{-2} sec^{-1} e^+e^- collider operating near charm threshold.** Schindler, R.H. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jun 1989. 24p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8902122–1: Results and perspectives in particle physics, LaThuile, Italy, 26 Feb - 4 mar 1989). Order Number DE89013894/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In this report, the potential for dedicated charmed D^0, D^+ and D_s meson physics in a high-luminosity e^+e^- collider operated near charm threshold is explored. The construction of such a high-luminosity collider or Tau-Charm Factory in conjunction with a new detector whose design draws heavily on the extensive operational experience of previous detectors at SPEAR, could achieve three orders-of-magnitude improvement in sensitivity in most areas of charmed meson studies. 27 refs., 10 figs., 9 tabs.

39430 (SLAC-PUB–5007) **Production of $Q^2\bar{Q}^2$ states.** Li, Bing An. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jun 1989. 7p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8905144–1: Tau-Charm workshop, Stanford, CA, USA, 23-27 May 1989). Order Number DE89013897/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In this talk, the production of $Q_2\bar{Q}^2$ states in two-photon collision and J/ϕ radiative decays are discussed. 15 refs., 7 figs.

39431 (SLAC-PUB–5012) **Results on D and D_s decays from Mark III.** Wasserbaech, S.R. Mark III Collaboration. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jun 1989. 7p. Sponsored by DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8903132–7: 24. Rencontres de Moriond: electroweak interactions and unified theories, Les Arcs, France, 5-12 Mar 1989). Order Number DE89013898/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The decays $D^0 \rightarrow \pi^- e^+ \nu_e$ and $D^0 \rightarrow K^- e^+ \nu_e$ are observed in a sample of $e^+e^- \rightarrow \psi(3770)$ events collected with the Mark III detector at SPEAR. The branching fractions $B(D^0 \rightarrow \pi^- e^+ \nu_e) = (0.39_{-0.11}{}^{+0.23}\pm0.04)\%$ and $B(D^0 \rightarrow K^- e^+ \nu_e) = (3.4\pm0.5\pm0.4)\%$ are measured. The ratio of Kobayashi-Maskawa matrix elements $|V_{cd}/V_{cs}|^2 = (0.057_{-0.015}{}^{+0.038}\pm0.005)$ is obtained under the assumption that the form factors $f_+{}^K(0)$ and $f_+{}^\pi$ are equal. A study of the absolute $D_s{}^+$ hadronic branching fractions is made by searching for fully reconstructed $e^+e^- \rightarrow D_s{}^{*\pm}D_s{}^\mp$ events at $\sqrt{s} = 4.14$ GeV. The 90% confidence level limit $B(D_s{}^+ \rightarrow \phi\pi^+) < 5.9\%$ is established. 23 refs., 2 figs.

39432 **Search for $K_L \rightarrow \pi^0\gamma\gamma$.** Papadimitriou, V. (The Enrico Fermi Institute and the Department of Physics, The University of Chicago, Chicago, Illinois 60637(US)); Gibbons, L. K.; Patterson, J. R.; Wah, Y. W.; Winstein, B.; Winston, R.; Woods, M.; Yamamoto, H.; Swallow, E. C.; Bock, G. *Physical Review Letters (USA)*, 63(1): 28-30 (3 Jul 1989).

A search for the rare decay mode $K_L \rightarrow \pi^0\gamma\gamma$ was performed using a data set from Fermilab experiment E-731. The decay is of interest in the context of chiral perturbation theory and for its contribution to the decay $K_L \rightarrow \pi^0 e^+ e^-$. The result is $B(K_L \rightarrow \pi^0\gamma\gamma) < 2.7 \times 10^{-6}$ (90% confidence level) which is nearly a two-order-of magnitude improvement over the previous best limit.

39433 **High-energy photoproduction of $\pi^+\pi^-\pi^0$, K^+K^-, and $p\bar{p}$ states.** Busenitz, J. (University of Illinois at Urbana-Champaign, 1110 West Green Street, Urbana, Illinois 61801(US)); Olszewski, C.; Callahan, P.; Gladding, G.; Wattenberg, A.; Binkley, M.; Butler, J.; Cumalat, J.; Gaines, I.; Gormley, M.; and others. *Physical Review [Section] D: Particles and Fields (USA)*, 40(1): 1-21 (1 Jul 1989).

We report measurements from elastic photoproduction of ω's on hydrogen for photon energies between 60 and 225 GeV, elastic ϕphotoproduction on hydrogen between 35 and 165 GeV and on deuterium between 45and 85 GeV, elastic photoproduction on deuterium of an enhancement at 1.72GeV/c^2 decaying into K^+K^-, and elastic andinelastic photoproduction on deuterium of pp^-pairs.

39434 **Measurement of inverse muon decay $\nu_\mu + e \rightarrow \mu^- + \nu_e$ at Fermilab Tevatron energies 15–600 GeV.** Mishra, S. R. (Columbia University, New York, New York 10027(US)); Bachmann, K. T.; Bernstein, R. H.; Blair, R. E.; Foudas, C.; Lefmann, W. C.; Leung, W. C.; Oltman, E.; Quintas, P. Z.; Sciulli, F. J.; and others. *Physical Review Letters (USA)*, 63(2): 132-135 (10 Jul 1989).

We report on a measurement of inverse muon decay $\nu_\mu + e \rightarrow \mu^- + \nu_e$ at the Fermilab Tevatron. A sample of 1151 inverse-μ-decay events, produced by neutrinos with laboratory energy in the range $15 \leq E_\nu \leq 600$ GeV, is extracted. We measure the rate of this

reaction with respect to the ν_μ-*N* charged-current interaction to be $[0.125\pm0.009(\text{stat})\pm0.003(\text{syst})]\times10^{-2}$. The measurement supports *V—A* structure of the weak current, left-handed two-component neutrinos, and a cross section rising linearly with respect to the center-of-mass energy.

39435 Search for the production of fractionally charged particles in e^+e^- annihilations at $\sqrt{s}$ =10.5 GeV. Bowcock, T. (Harvard University, Cambridge, Massachusetts 02138(US)); Kinoshita, K.; Mauskopf, P.; Pipkin, F. M.; Procario, M.; Wilson, R.; Wolinski, J.; Xiao, D.; Baringer, P.; Haas, P.; and others. *Physical Review [Section] D: Particles and Fields (USA)*, 40(1): 263-266 (1 Jul 1989).

We report the results of a search for particles with electric charge $Q=(2/3)e$ produced in e^+e^- annihilations at W=10.5 GeV. The ratio of the cross section for the inclusiveproduction of fractionally charged particles (q) to the dimuon pointcross section, $R_q=\sigma(e^+e^-\rightarrow qX)/\sigma(e^\pm\rightarrow\mu^+\mu^-)$, is found to have an upper limitat a 90%confidence level of 1.0×10^{-4} for masses less than3.5 GeV/c^2.

39436 Production of pseudoscalar mesons in 300 GeV central π^-N collisions. Alde, D. (Los Alamos National Lab., NM (USA)); Knapp, E.A.; Bellazzini, R.; Brez, A.; Massai, M.M.; Torquati, M.R.; Binon, F.G.; Bricman, C.; Stroot, J.P.; Boutemeur, M. IHEP-IISN-LANL-LAPP-Pisa Collaboration. *Zeitschrift fuer Physik [Sektion] C: Particles and Fields (F.R. Germany)*, 43(4): 541-547 (Aug 1989).

The exclusive production of π^0, eta and eta' mesons in π^-N central collisions has been studied with 300 GeV incident pions. The experiment has been performed at the CERN SPS. The gammas from decaying mesons were detected in the hodoscope multiphoton spectrometer GAMS-4000. The measured differential cross sections show a plateau in the longitudinal momentum interval $0.1<x_F<0.3$. (orig.).

6452 Particle Interactions and Properties - Theoretical

Refer also to citation(s) 38877, 39368, 39428

39437 (DOE/ER/01428–T6) **[High energy particle physics at Purdue]: Task F: Annual progress report for 1989.** Fischbach, E. Purdue Univ., Lafayette, IN (USA). Dept. of Physics. 1989. 36p. Sponsored by DOE Energy Research. DOE Contract AC02-76ER01428. Order Number DE89015047/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report discusses the following topics: models of the fifth force; limits on the coupling of kaons to new fields; and detection of hyperphotons in kaon decays. 56 refs., 4 figs., 2 tabs. (LSP)

39438 (INIS-mf–11457(v.1,2) v. 2) **Theory of clusters.** Hawrynski, M.J. (Inst. of Occupational Medicine, Lodz (Poland)). Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The theory of the interaction between ions contained in the air and water molecules is described in this paper. The theory considers mainly with interaction of ionised radon decay products and vapour molecules. The theory refers to the range of natural humidity - from 5 percent to 100 percent of air relative humidity. The expected radia of clusters of ion and vapour molecules, their diffusion coefficient and the time of their forming have been calculated as a function of air relative humidity. The conclusions contain the typical predicted features of the radon daughter clusters that can occur in ambient air.

39439 (JINR-E–2-88-418) **Hadron transverse momenta in inclusive reactions in the quark-gluon string model.** Lykasov, G.I.; Slavin, N.V. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1988. 14p. Order Number DE89630641/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to the journal Yad. Fiz.

The mechanism of allowance for dependence of distribution functions of quarks, diquarks and their fragmentation into hadrons on a transverse momentum K_t is proposed in the frame of the quark-geuon string model. The consequent division of K_t between 2n-quark-antiquark chains or n-Pomeron showers is supposed. Hadron and hadron-nuclear processes are analysed: the dependence of the average π-meson transverse momentum in the p-p collision on x, hadron inclusive spectra in p-A interactions at fixed and different hadron transverse momenta are calculated. A strong dependence of the observed values on the number n is derived in this method, it is of special importance for the analysis of hadron-nucleus collisions. 21 refs.; 6 figs.

39440 (JINR-E–2-88-521) **Confirmation of rho' (1250) in $e^+e^-\rightarrow\pi^+\pi^-$ by means of the unitarized analytic VMD model of the pion form factor.** Dubnicka, S.; Furdik, I.; Meshcheryakov, V.A. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1988. 11p. Order Number DE89630642/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The occurence of rho' (1250) resonance in $e^+e^-\rightarrow\pi^+\pi^-$ is confirmed by means of the analysis of all existing reliable pion form factor data using the unitarized analytic VMD model with the asymptotic behaviour predicted by QCD up to the logarithmic correction. The determined resonance mass $m_{rho'}$=1422±90 Mev coincides with the value obt ained recently by other authors from the processes $e^+e^-\rightarrow\pi^+\pi^-\rightarrow\pi^0\omega$ by means of the parametrization of the corresponding cross sections only by a superposition of Breit-Wigner formulas. 21 refs.; 4 figs.

39441 (JINR-R–2-88-427) **Behaviur of $R=\sigma_L/\sigma_T$ ratio in QCD at x->0 and x ->1 and its parametrizations.** Kotikov, A.V. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1988. 10p. (In Russian). Order Number DE89630629/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to the journal Yad. Fiz.

The behaviour of $R=\sigma_L/\sigma_T$ ratio is considered (where σ_L and σ_T are cross sections of longitudinal and transverse polarized photon scattering in nucleon) at x->0 and x->1 in the first two orders of perturbation theory. Simple parametrizations are constructed. The result was obtained both on the basis of a standard procedure and with using scheme-invariant perturbation theory. The contribution is also taken into account of nucleon mass and of transverse momentum of parton in nucleon. 26 refs.; 1 fig.

39442 (NIKHEF-H–89-3) **QCD Compton scattering at HERA energy.** Engelen, J.J.; Jong, S.J. de; Laterveer, R.; Vermaseren, J.A.M. Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H. Feb 1989. 12p. Order Number DE89630630/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

We present total and differential cross sections for QCD Compton scattering in electron proton collisions at HERA Energy. The electron photon vertex is taken into account explicitly, and the Q^2 of the exchanged photon ranges from nearly zero (almost real photon) to the kinematically allowed maximum. In our approach the QCD scale is set by the invariant mass of the produced quark and gluon. (author). 14 refs.; 4 figs.; 1 tab.

39443 (UWThPh–1988-37) **On the Q^2-dependence of quark and diquark fragmentation functions.** Bartl, A. Vienna Univ. (Austria). Inst. fuer Theoretische Physik. 1988. 9p. Order Number DE89630643/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The Q^2-dependence of quark and diquark fragmentation functions is studied by means of evolution equations and compared with the experimental data. Some comments on the evolution of charm quark fragmentation are also presented. 20 refs., 4 figs.

39444 (UWThPh–1988-41) **Status of CP violation.** Grimus, W. Vienna Univ. (Austria). Inst. fuer Theoretische Physik. 1988. 28p. Order Number DE89630621/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A short review of the status of CP violation is given. First, the notion of a general CP transformation is presented. Then the CP violating parameters ϵ and ϵ' of the decays K^0, K-bar^0 ->PIPI are

defined and discussed in the context of the standard model and experimental results. Extensions of the standard model are considered with emphasis on the origin of CP violating phases. Finally we take a look on future tests of CP violation. 70 refs., 7 figs.

39445 (UWThPh–1989-10) **Estimate of the background gluon correlation time from bottonium.** Kraemer, A.; Dosch, H.G.; Bertlmann, R.A. Vienna Univ. (Austria). Inst. fuer Theoretische Physik. 1989. 7p. Order Number DE89630644/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Assuming that a Coulombic quarkonium is interacting with a stochastically fluctuating gluon background we determine the gluon correlation time from the upsilon Υ(9,46) data. We find the result T_G=0,2-2,2fm, rather strongly dependent on the value of the static gluon condensate. 18 refs.

39446 Weak-boson production at Fermilab Tevatron energies. Berger, E. L. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439(US)); Halzen, F.; Kim, C. S.; Willenbrock, S. *Physical Review [Section] D: Particles and Fields (USA),* 40(1): 83-91 (1 Jul 1989). DOE Contract AC02-76ER00881.

Weak bosons are produced in hadron collisions by quarks and antiquarks withaverage fractional momenta $x=M_{W,Z}/\sqrt{s}$. When $\sqrt{s}$is increased by a factor of 3, the average value of x shifts fromabout 0.15 at CERN $p\bar{p}$ collider energies to 0.05 at the FermilabTevatron, i.e., from a regime where valence quarks dominate to a regime wheresea quarks dominate the production features of weak bosons. We investigatesystematically the problem of calculating W and Z cross sections inthis new regime, paying special attention to the ratio$\sigma(W)/\sigma(Z)$ which is necessary for determining the ratio oftotal widths $\Gamma(W)/\Gamma(Z)$ from hadron-collider data. Weemphasize that with the increased statistics in $p\bar{p}$ experiments, theparton fluxes responsible for the production of weak bosons can be controlledinternally by a study of the asymmetry of the rapidity distribution of the$W$ boson. We derive a relation between the asymmetry in $W^{\pm}$rapidity distributions and the ratioF_2^n/F_2^p of deep-inelastic lepton-hadronscattering structure functions. The production rates of weak bosons also becomesensitive to production via the charm quark. This calculation raises someinteresting theoretical issues. We discuss both problems in detail. We alsostudy the implications of our results for the determination of the number oflight neutrinos and the mass of the top quark via a measurement of the$W$-to-Z event ratio.

39447 Heavy flavor resonances and QED radiative corrections. Alexander, J.P. (Lawrence Berkeley Lab., CA (USA)); Bonvicini, G.; Drell, P.S.; Frey, R.; Lueth, V. *Nuclear Physics [Section] B (Netherlands),* 320(1): 45-60 (26 Jun 1989). DOE Contract AC03-76SF00515;AC03-76SF00098;AC02-76ER01112.

We discuss QED radiative corrections applied to narrow resonances in e^+e^- annihilation. We establish a simple and precise prescription for extracting radiative corrections from experimental data. This prescription differs from those used in measurements of charm and bottom resonances and leads to resonance parameters which are significantly different. Using a simulation method, we calculate these differences, and conclude that the masses and widths of psi and Υ resonances change by up to three standard deviations from presently accepted values. (orig.).

39448 Lower bound on axigluon mass from electron-positron annihilation. Cuypers, F. (Department of Physics and Astronomy, University of North Carolina, Chapel Hill, North Carolina 27599-3255(US)); Frampton, P. H. *Physical Review Letters (USA),* 63(2): 125-127 (10 Jul 1989).

We compute the cross-section ratio R in e^+e^- scattering in chiral color theory and provide a new lower limit on the axigluon mass of 65 GeV if Λ_{QCD}=100 MeV, or 100 GeV if Λ_{QCD}=200 MeV.

39449 Axions, SN 1987A, and one-pion exchange. Turner, M. S. (Departments of Physics and Astronomy & Astrophysics, The University of Chicago, Chicago, Illinois 60637-1433, NASA/Fermilab Astrophysics Center, Fermi National Accelerator Laboratory, Batavia, Illinois 60510-0500(US)); Kang, H.; Steigman, G *Physical Review [Section] D: Particles and Fields (USA),* 40(2): 299-308 (15 Jul 1989).

The axion mass constraint which follows from SN 1987A, the exclusion ofaxion masses between 10^{-3} eV and 2 eV, is the moststringent astrophysical bound, and as such has received much scrutiny.Nucleon-nucleon, axion bremsstrahlung is the primary mechanism for axionemission from the nascent neutron star associated with SN 1987A, and the ratefor this process has been calculated in the one-pion-exchange (OPE)approximation. It has been suggested that by using OPE to calculate the crosssection for the analogue process, $pp\rightarrow pp+\pi^0$, and comparingthe result to experimental data one can test the validity of thisapproximation. We have carefully evaluated the cross section for$pp\rightarrow pp+\pi^0$ using OPE and find excellent agreement (to betterthan a factor of 2) with the experimental data. Within the context of thenonlinear sigma model we also address the effects of finite density on axionemission, and conclude that these effects are likely to change the axionemission rate by at most a factor of a few (and could even *enhance* theaxion emission rate). Thus we conclude that the axion emission rate based uponOPE is reliable to at least a factor of a few, thereby validating the verystringent limits to the axion mass based upon SN 1987A.

39450 New tripreon models with semisimple metacolor groups. Lu, G. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011(US)); Young, B.; Zhang, X.; Wan, L. *Physical Review [Section] D: Particles and Fields (USA),* 40(1): 223-230 (1 Jul 1989). DOE Contract W-7405-ENG-82.

A systematic analysis of the *chiral* tripreon models with $SU(N)\times SO(M)$-metacolor symmetry is made. Unique solutions to the 't Hooft anomaly-matching condition with the Bars constraint are obtained for $SU(3)\times SO(5)$ models which also satisfy complementarity. Both the metacolor group and the gauged color-flavor subgroup of the metaflavor group are asymptotically free. A model which has a low-metacolor-energy scale and three generations of composite fermions with the quantum numbers of quarks and leptons of the standard model is obtained.

39451 Bourdeau and Mukhopadhyay reply. Bourdeau, M. (High Energy Physics Group, Syracuse University, Syracuse, New York 13210(US)); Mukhopadhyay, N. C. *Physical Review Letters (USA),* 63(3): 335-335 (17 Jul 1989).

A reply to the criticism by Abbas on the choice of the Δ wave functi inthe approach of Vento, Baym, and Jackson (VBJ) is given. It is further concluded that Abbas's suggestion is unfounded (AIP).

6453 Particle Invariance Principles and Symmetries

Refer also to citation(s) 39450, 39462, 39463, 39465, 39471

6454 Field Theory

Refer also to citation(s) 39367

39452 (INIS-mf–11480, pp. 11-12) **Investigation on one-dimensional Dirac equation.** Bulla, W.; Unterkofler, K. Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik. Nov 1988. (In German). In *Annual report of the Institute for Theoretical Physics in Graz, Austria.* Order Number DE89631627/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

DIRAC OPERATORS/perturbation theory; DIRAC OPERATORS/polymers; POLYMERS/mathematical models; POLYMERS; PROGRESS REPORT

39453 (IYaF–88-75) **Bi-self-similar wave collapse.** Malkin, V.M. AN SSSR, Novosibirsk (USSR). Inst. Yadernoj Fiziki. 1988. 5p. (In Russian). Order Number DE89630136/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The new type of wave collapse regimes is predicted. This prediction permit to clarify the dynamics of nonlinear wave fields, which are incline to self-focusing, but have no stable self-similar regimes of strong collapse. 5 refs.

39454 (JINR-D–17-88-95, pp. 365-370) **Hydrodynamics as a Galilei invariant field theory.** Takashi, Ya. (Alberta Univ., Edmonton, AB (Canada). Theoretical Physics Inst.). Joint Inst. for Nuclear Research, Dubna (USSR). 1988. (CONF-8708341–: 4. International symposium on selected topics in statistical mechanics, Dubna,

USSR, 25-29 Aug 1987). In *4. International symposium on selected topics in statistical mechanics.* Order Number DE89012150/JAW. Available from NTIS (US Sales Only), PC A21/MF A01; INIS.

A close relation between macro and micro theories is shown. A Lagrange formalism of hydrodynamics is presented. The Galilei invariance is used and the macro theory-hydrodynamics is obtained from a Galilei invariant micro theory, in particular, from the quantized Schroedinger field theory. Having constructed invariants out of possible variables, the simplest non-trivial Lagrangian is set up, from which such quantities as the energy and momentum are derived. Then the variables chosen are separated out from the micro theory. 5 refs.

39455 (JINR-R–4-88-587) **On the construction of the scattering matrix for locally-noncommutative interactions of relativistic fields.** Zorin, A.V.; Kuryshkin, V.V.; Entralgo, E.E. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1988. 16p. (In Russian). Order Number DE89630138/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

It is shown that a covariant, unitary and causal scattering matrix for relativistic quantum-field models with locally-noncommutative interaction lagrangians can be constructed by the Bogolubov method when a new covariant chronological ordering operation is introduced. The explicit form for the required ordering is obtained, its main properties are studied, the comparison with the standard (noncovariant) time-ordering, as well as with the covariant chronological orderings proposed earlier by Yukawa, Koba and Golfand is performed. 27 refs.; 20 figs.

39456 (NIKHEF-H–88-19) **Operator product coefficients in non-diagonal conformal field theories.** Fuchs, J. Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H. Nov 1988. 8p. Order Number DE89630141/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The authors explain the problems involved in the determination of operator product coefficients in non-diagonal conformal field theories. Two methods are used to derive formulae which allow to compute these coefficients. A careful treatment of this issue of uniqueness of the results proves to be necessary. (author). 14 refs.

39457 (UWThPh–1989-2) **Interaction vertices in reduced string field theories.** Embacher, F. Vienna Univ. (Austria). Inst. fuer Theoretische Physik. 1989. 19p. Order Number DE89630145/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

In contrast to previous expectations, covariant overlap vertices are not always suitable for gauge-covariant formulations of bosonic string field theory with a reduced supplementary field content. This is demonstrated for the version of the theory suggested by Neveu, Schwarz and West. The method to construct the interaction, as formulated by Neveu and West, fails at one level higher than these authors have considered. The condition for a general vertex to describe formally a local gauge-invariant interaction is derived. The solution for the action functional and the gauge transformation law is exhibited for all fields at once, to the first order in the coupling constant. However, all these vertices seem to be unphysical. 21 refs.

39458 (UWThPh–1989-8) **Stochastic temperature and the Nicolai map.** Hueffel, H. Vienna Univ. (Austria). Inst. fuer Theoretische Physik. 1989. 7p. Order Number DE89630146/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Just as standard temperature can be related to the time coordinate of Euclidean space, a new concept of 'stochastic temperature' may be introduced by associating it to the Parisi-Wu time of stochastic quantization. The perturbative equilibrium limit for a self-interacting scalar field is studied, and a 'thermal' mass shift to one loop is shown. In addition one may interpret the underlying stochastic process as a Nicolai map at nonzero 'temperature'. 22 refs.

39459 (UWThPh–1989-16) **On Finkelstein's hyperspin manifold structure and the space problem of H. Weyl.** Urbantke, H. Vienna Univ. (Austria). Inst. fuer Theoretische Physik. 1989. 3p. Order Number DE89630144/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

A recent criticism of the claimed existence of torsion-free connections compatible with a hypermanifold structure in Finkelstein's sense is reinforced by relating the problem to the space problem of H. Weyl as generalized by Cartan and Freudenthal. Some historical remarks concerning the development of the latter are also included. 11 refs.

39460 Unambiguous fermionic-string amplitudes. La, H. (Physics Department, Boston University, Boston, Massachusetts 02215(US)); Nelson, P. *Physical Review Letters (USA),* 63(1): 24-27 (3 Jul 1989).

We show how to treat boundary divergences in heterotic string theory covariantly and unambiguously. The method applies even to theories with nonvanishing tadpoles; in this case the Fischler-Susskind mechanism sufficies to ensure well defined answers. Also n-point functions are well defined with no special string-tension renormalizations. As an example we find the loop corrections to the linearized background equations of motion for the $O(16)\times O(16)$ string needed to give unambiguous, finite scattering amplitudes. No splitting or projection of supermoduli space is needed.

39461 Comment on "Gravitational corrections to Yang-Mills Chern-Simons terms". Hagen, C. R. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627(US)); Ramaswamy, S. *Physical Review Letters (USA),* 63(2): 213-213 (10 Jul 1989).

A Comment on the Letter by A. Lerda and P. Van Nieuwenhuizen, Phys. Rev. Lett. 62, 1217 (1989).

39462 Unitarity constraints on grand unified models. Durand, L. (Department of Physics, University of WisconsinMadison, Madison, Wisconsin 53706(US)); Lopez, J. L. *Physical Review [Section] D: Particles and Fields (USA),* 40(1): 207-222 (1 Jul 1989).

We present a simplified method for the calculation of low-energy unitarity constraints on grand unified broken-supersymmetric models based on the Goldstone-boson equivalence theorem for high-energy scattering in gauge theories, the fermion-boson equivalence theorem for supersymmetric theories, and the evolution of couplings under the renormalization group. We apply the method to the "flipped" $SU(5)\times U(1)$ superstring model, obtain high-energy unitarity constraints at the grand unified scale $M_G=4\times10^{16}$ GeV, and then use the renormalization-group equations to evolve the constraints to the low-energy mass scale M_W. We investigate the peculiarities of the renormalization-group flow and the existence of critical surfaces at which the scalar superpotential couplings diverge at M_G. We find upper bounds on the superpotential couplings at low energies and use these to establish absolute upper bounds on the top-quark mass, $m_t\lesssim200$ GeV, and on the lightest neutral-Higgs-boson mass, $M_{H_1^0}\lesssim155$ GeV in the $SU(5)\times U(1)$ model. We also obtain an upper bound on $M_{H_1^0}$ as a function of m_t which shows that $M_{H_1^0}\lesssim125$ GeV for favored values of the ratios of Higgs vacuum expectation values.

39463 Extended Sugawara construction for the superalgebras SU(M+1|N+1). II. The third-order Casimir algebra. Bouwknegt, P. (Center for Theoretical Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139(US)); Ceresole, A.; van Nieuwenhuizen, P.; McCarthy, J. *Physical Review [Section] D: Particles and Fields (USA),* 40(2): 415-421 (15 Jul 1989).

The machinery developed in paper I is used to compute the operator-productalgebra (OPA) of an operator constructed from the third-order Casimir invariantof the superalgebra SU($m|n$). The vertex operator construction of$SU(m|n)^{(1)}$ is used to find a realization of the OPA forlevel k=1 in terms of free bosonic fields only. It turns out that inmany respects the conformal structure of the affinized Lie superalgebra$SU(m|n)^{(1)}$ is similar to that of theKač-Moody algebra $SU(m-n)^{(1)}$. Anintermediate result suggests the occurrence of extended conformal symmetries inbc systems, to which we will devote a separate discussion.

39464 Instability of higher-difference initial-value theories. Eliezer, D. A. (Department of Physics, University of California, Santa Barbara, California 93106(US)); Woodard, R. P. *Physical Review [Section] D: Particles and Fields (USA),* 40(2): 465-472 (15 Jul 1989).

Temporal discretization is developed as a means of studying thenonperturbative stability of nonlocal actions such as those of

string theoryand third-quantized gravity. An algorithm is derived for constructing theclassical canonical Hamiltonian which generates the natural interpolation ofcontinuous time evolution for Lagrangian higher-difference theories. Using thisquantity we prove the analog of Ostrogradski's result for continuum higherderivatives: namely, that every nondegenerate, deterministic higher-differencetheory is unstable. This result is nonperturbative and survives quantization.An explicit construction is given for the energy of a general quadraticLagrangian with arbitrarily high differences.

39465 Classification of two-dimensional conformal supergravity theories with finite-dimensional algebras. McCabe, J. (Department of Physics, University of Florida, Gainesville, Florida 32611(US)); Velikson, B. *Physical Review [Section] D: Particles and Fields (USA)*, 40(2): 400-407 (15 Jul 1989).

We present a list of all the finite supersymmetric extensions of thetwo-dimensional (2D) conformal algebra SO(2,2), which could lead to 2D superconformal gravity theories. The on-shell matter multiplets of the algebrasallowing canonical spin-0 and -1/2 matter are constructed. Usingthese multiplets the Weyl and Yang-Mills anomalies are calculated. There aremany new models. One new model is free of both Yang-Mills and Weyl anomalies,$SU(1,1)\times SU(2|1,1)$, but only the algebras$SU(1,1)^2$, $OSP(1|2)^2$,$OSP(2|2)^2$, $SU(1,1)\times OSP(1|2)$,$OSP(1|2)\times OSP(2|2)$, and$SU(1,1)\times OSP(2|2)$ lead to models free of all anomalies. Thesemodels correspond to the known string models.

39466 Rigorous extension of the proof of zeta-function regularization. Elizalde, E. (Department of Structure and Constituents of Matter, Faculty of Physics, University of Barcelona, Diagonal 647, 08028 Barcelona, Spain(ES)); Romeo, A. *Physical Review [Section] D: Particles and Fields (USA)*, 40(2): 436-443 (15 Jul 1989).

The proof of ζ-function regularization of high-temperature expansions, a technique which provides correct results for many field-theoretical quantities of interest, is known to fail, however, in the case of "Epstein-type" expressions such as$\Sigma'^{\infty}_{n_1,\ldots,n_N=1}$ $(\Sigma^N_{j=1} a_j i^{\alpha})^{-s}$, $\alpha=2,4,\ldots$. After showing where precisely the existing demonstration breaks down, we provide a new proof of this regularization valid for a wider range of the parameter α. The extra terms are calculated explicitly for any value of $\alpha\leq 2$. As an application, we provide the finite results corresponding to the ζ-function regularization of expressions associated with field theories evaluated in partially compactified, toroidal spacetimes of the form $T^p\times R^{q+1}$.

39467 Pure lattice gauge theory in intermediate volumes. I. Berg, B. A. (Department of Physics and Supercomputer Computations Research Institute, The Florida State University, Tallahassee, Florida 32306(US)); Billoire, A. H. *Physical Review [Section] D: Particles and Fields (USA)*, 40(2): 550-583 (15 Jul 1989).

We investigate numerically the mass spectrum, string tension, deconfinementtemperature, and lattice β function for pure SU(2) lattice gaugetheory. Our data cover medium-sized volumes. Finite-size-scaling concepts areemphasized.

39468 Pure lattice gauge theory in intermediate volumes. II. Vohwinkel, C. (Department of Physics and Supercomputer Computations Research Institute, The Florida State University, Tallahassee, Florida 32306(US)); Berg, B. A. *Physical Review [Section] D: Particles and Fields (USA)*, 40(2): 584-587 (15 Jul 1989).

We investigate numerically the mass spectrum and string tension for pureSU(3) lattice gauge theory in medium-sized volumes.

39469 Purely gluonic soliton solutions in the leading-logarithm model. Xu, G. (Department of Physics, University of California, Riverside, California 92521(US)); Desai, B. R. *Physical Review [Section] D: Particles and Fields (USA)*, 40(2): 620-631 (15 Jul 1989).

Finite-energy, purely gluonic, soliton solutions are considered in atwo-dimensional space on the basis of the leading-logarithm model which isequivalent to electromagnetism with a dielectric constant ϵlogarithmically proportional to the fields. Solutions, in the absence ofsources, are possible provided $\epsilon>0$ and $\epsilon<0$ are bothpresent in the same space.

39470 Table for constructing the spin coefficients in general relativity. Cocke, W. J. (Steward Observatory, University of Arizona, Tucson, Arizona 85721(US)). *Physical Review [Section] D: Particles and Fields (USA)*, 40(2): 650-651 (15 Jul 1989).

The spin coefficients in spinor calculus in Riemannian space-time are linear functions of the curls of the connecting quantities (the Infeld–Van der Waerden symbols). We show that in the Newman-Penrose formalism the expressions for the spin coefficients are quite manageable, if they are written in terms of the Newman-Penrose tetrad vectors. We present a table of the components of the spin coefficients explicitly in terms of the curls of the individual tetrad vectors.

39471 Anomalous moments in N=2 and 4 supersymmetries. Lee, B. (Department of Physics, Columbia University, New York, New York 10027(US)). *Physical Review [Section] D: Particles and Fields (USA)*, 40(2): 607-612 (15 Jul 1989).

We calculate anomalous magnetic moments of charged particles with spin 1/2 and anomalous electric quadrupole moments of spin-1particles in N=2 and N=4 supersymmetric Yang-Mills theorieswith a spontaneously broken gauge group. All the anomalous moments vanish for$N$=4 while they do not vanish for N=2.

39472 Hamiltonian reduction for massive fields coupled to sources. Marzban, C. (Institute of Field Physics, Department of Physics and Astronomy, University of North Carolina, Chapel Hill, North Carolina 27599-3255 (US)); Whiting, B. F.; Van Dam, H. *Journal of Mathematical Physics (New York) (USA)*, 30(8): 1877-1892 (Aug 1989).

The Dirac–Bergmann formalism for handling constrained dynamical systems is applied to massive and massless spin-2 field theories in Minkowski space. In the process, it is shown that an extension of the formalism is required before the true Hamiltonian on the reduced phase space can be calculated. With this extension, the approach then allows a revealing exposition of the $m\rightarrow 0$ limit of the massive theory, particularly of the requirement for the conservation of sources, and reconfirms the experimentally observable discontinuity which occurs at m=0.

65 PHYSICS II

6510 Nuclear Physics

39473 (DOE/ER/40150–77) **Research program at CEBAF (III): Report of the 1987 summer study group, June 1–August 28, 1987.** Burkert, V.; Gross, F.; Mecking, B.; Mougey, J.; Nanda, S.; Whitney, R. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jan 1988. 616p. Sponsored by DOE Energy Research. DOE Contract AC05-84ER40150. (CONF-8706200–: CEBAF summer workshop, Newport News, VA, USA, 22-26 Jun 1987). Order Number DE89014422/JAW. Available from NTIS, PC A99/MF A01 - OSTI; GPO Dep.

An informal Study Group consisting of the CEBAF scientific staff and about 43 visiting scientists met during the summer of 1987 to discuss issues of importance to planning the CEBAF scientific program. The contributions to this volume grew out of these discussions, and out of additional discussion with the User community and with CEBAF's new Associate Director for Research, John Domingo, which extended into the fall of 1987. Reports of the 1985 and 1986 Summer Study Groups have been previously published by CEBAF under the title Research Programs at CEBAF (RPAC) and hence it is appropriate to refer to this volume as RPAC III. The contributions to this volume have been organized into the following six general areas reflecting the focus of principle activities during this period: High Resolution Spectrometers; Large Acceptance Spectrometer; Out-of-Plane Experiments at CEBAF; Neutron Detection at CEBAF; Illustrative Experiments and Experimental Design; and Theory.

39474 (INIS-GB–191) **Nuclear physics research report 1988.** Surrey Univ., Guildford (UK). Dept. of Physics. 1988. 111p. Order Number DE89631626/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

The paper presents the 1988 Nuclear Physics Research Report for the University of Surrey, United Kingdom. The report includes both experimental nuclear structure physics and theoretical nuclear physics research work. The experimental work has been carried out predominantly with the Nuclear Structure Facility at the SERC Daresbury Laboratory, and has concerned nuclear shapes, shape coexistence, shape oscillations, single-particle structures and neutron-proton interaction. The theoretical work has involved nuclear reactions with a variety of projectiles below 1 GeV per nucleon incident energy, and aspects of hadronic interactions at intermediate energies. (U.K.).

39475 (INIS-SU–78, pp. 169) **γ-quantum spectrum from the 144 keV neutron capture reaction by ^{191}Ir nucleus.** Murzin, A.V. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yademykh Issledovanij); Kononenko, I.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

IRIDIUM 191 TARGET/neutron reactions; IRIDIUM 192/energy-level transitions; CAPTURE; D STATES; GAMMA RADIATION; GROUND STATES; KEV RANGE 100-1000; P STATES

39476 (INIS-SU–78, pp. 258-261) **Elastic scattering of intermediate neutrons by ^{92}Mo, ^{94}Mo, Dy, Er, Ta, W, Re and ^{238}U nuclei.** Kuznetsova, L.V. (Joint Inst. for Nuclear Research, Dubna (USSR)); Popov, A.B.; Samosvat, G.S. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

Differential elastic scattering cross sections of neutrons with energies below 500 keV were measured to determine strength functions S^l and radii of scattering R_l' for l=0 and l=1. For heavy nuclei the contribution of inelastic scattering was taken into account with the help of the Hauser-Feshbach formula. There are given the S^l and R_l' values for the ^{92}Mo, ^{94}Mo, Dy, Er, Ta, W, Re and ^{238}U nuclei. 11 refs.; 2 tabs.

39477 (KIFVE–88-04) **Study on total destruction of atomic nuclei in inelastic hadron-nucleus collisions at momentum of 40 GeV/c.** Boos, Eh.G.; Mosienko, A.M.; Shcherbina, L.I. and others. AN Kazakhskoj SSR, Alma-Ata (USSR). Inst. Fiziki Vysokikh Ehnergij. 1988. 18p. (In Russian). Order Number DE89630726/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

New data on total destruction of lithium, carbon, sulphur, copper, cesium-iodine and lead nuclei received with strimmer chamber at antiproton, K^- and π^--mesons momentum of 40 GeV/c are given. The selection procedure for the events is suggested. Multiplicities of positive and negative particles, ratios of standard deviation to average multiplicity are studied. For the first time the total destruction probability dependence against target nucleus atomic number is obtained. 13 refs.; 11 figs.; 4 tabs.

39478 (LA-UR–89-2057) **Introducing NJOY 89.** McFarlane, R.E. Los Alamos National Lab., NM (USA). 1989. 27p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-8906162–1: OECD seminar-workshop on NJOY and THEMIS and the NEA data bank, Saclay, France, 20-21 Jun 1989). Order Number DE89014309/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A new version of the NJOY Nuclear Data Processing Code is described. This version is called NJOY 89, and it supports most of the features of the new ENDF-6 format including the Reich-Moore and Hybrid R-Function resonance representations, heating and damage calculations that make use of File 6 energy-angle distributions, the revised File 7 format for the thermal data, and multigroup transfer matrices based on File 6. The multigroup matrices can be computed for incident neutrons or charged-particles, and for outgoing neutrons, photons, charge particles, and recoil nuclei. The MATXS output module has been upgraded to handle charged particles in order to enable the TRANSX code to prepare multiparticle coupled sets. The plotting module can display ENDF-6 format File 6 data in both 2-d and 3-d perspective forms. In addition, some remaining problems are discussed. 16 refs., 8 figs.

39479 **Recent references January through April 1989.** Ramavataram, S. (Brookhaven National Laboratory, Upton, New York 11973, USA(US)). *Nuclear Data Sheets (USA),* 57(2): 117-118 (Jun 1989). DOE Contract AC02-76CH00016.

A reaction index and a bibliography are given for all literature received by the National Nuclear Data Center or assigned key numbers between January and April, 1989. (AIP)

6511 Experimental Techniques

39480 (FRCEA-TH–92) **Study of the nucleus-nucleus interaction potentiel via ^{16}O elastic scattering at 94 MeV/u.** Roussel, P. Paris-11 Univ., 91 - Orsay (France). Jun 1986. 135p. (In French). Order Number DE89791992/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

The elastic scattering angular distributions of ^{16}O at 94 MeV/u on ^{12}C, ^{28}Si, ^{40}Ca, ^{90}Zr, ^{208}Pb targets have been measured. They have been analyzed in the framework of the optical model with Woods-Saxon potentials and in the framework of the folding model. Concerning the heaviest system ^{16}O + ^{208}Pb, these analyses show that the real potential is well-defined only in the vicinity of the strong absorption radius, whereas for the lighter systems, it is defined in a relatively wide region (2-3 fm), which corresponds to a strong overlap of the two nuclei, especially for the systems ^{16}O + ^{28}Si and ^{16}O + ^{12}C. This difference, between the ^{16}O + ^{208}Pb system and the other systems originates in the appearance of the far-side contribution which manifests itself in the angular distributions by the so-called Fraunhoefer oscillations. The imaginary part of the potential is determined only in the vicinity of the strong absorption radius. The large reduction of the strong absorption radius for all the studied systems as the energy increases shows that the nuclear surface transparency is strongly enhanced at intermediate energies. The calculations performed with folding potentials allowed a study of the nuclear potential strength, in a less ambiguous way than with phenomenological potentials. In the regions where they are well-defined, the real and imaginary potentials decrease regularly when the energy goes from 10 to 100 MeV/u. This decrease disagrees with the results of microscopic calculations which predict an increase or a saturation of the nuclear potential in this energy range.

39481 (GANIL-P–89-04) **Birth, life and death of hot nuclei.** Suraud, E.; Tamain, B.; Gregoire, C. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). Jan 1989. 117p. Order Number DE89792001/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

Intermediate energy heavy-ions (10-100 MeV/u) are the most powerful tool to study hot nuclear matter properties. In this paper we give a review of experimental and theoretical works which support this statement. The first challenge is to achieve hot nuclei formation. The second one is to study their properties. The formation step is governed by the relative influence of nucleon-nucleon collisions and mean field effects. Fundamental quantities such as excited matter decay time, thermalization time, relaxation time for collective modes are of major importance and are compared with typical collision times. It appears that semi-classical theories are able to give a reasonable description of the collision and that they are a good guide for defining further experiments. We show how it has been possible to experimentally establish that very hot equilibrated nuclei are really formed. Their decay properties are not basically different from decay properties at lower bombarding energy. However specific channels are open: in that sense, we take stock of the multifragmentation process. Moreover, compression effects may be an important feature of this energy range. Future studies will involve heavier projectiles around 30-50 MeV/u. They will be the best probe for hot and compressed nuclear matter studies.

39482 (IPNO-DRE–88-16) **Collective excitations of spin-isospin modes.** Roy-Stephan, M. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1988. 15p. (CONF-8806117–:

3. international conference on nucleus nucleus collisions, Saint-Malo, France, 6-11 Jun 1988). Order Number DE89792003/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The response of nuclei to spin-isospin excitation which is displayed through heavy ion induced charge-exchange reactions, is concentrated in two excitation energy domains. At low excitation energy, several particle-hole states contribute: the Gamow-Teller resonance and higher multipolarity spin flip resonances. Around 300 MeV, a nucleon from the target is excited to a Δ resonance. On an average, the strength in the Δ sector has the same order of magnitude as in the nuclear sector. In detail, the Δ excitation strength depends on the nuclear structure of the projectile-ejectile pair. The peak corresponding to Δ excitation in nuclei is energy shifted from the peak of the free Δ created in the reaction on hydrogen.

39483 (IPNO-DRE–88-29) **Light Ions induced charge exchange reactions at Saturne.** Bachelier, D.; Boyard, J.L.; Jourdain, J.C.; Roy-Stephan, M.; Bedjidian, M.; Contardo, D.; Goodman, C.; Brockstedt, A.; Osterlund, M.; Ellegaard, C. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1988. 6p. Order Number DE89792005/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

Spin isospin excitations are studied at Laboratoire National Saturne using charge exchange reactions. New data, completing the (^{3}He,t) one, have been recently obtained. We present measurements done on the (d,2p) reaction with a special emphasis on the quasi free and Δ regions. Spin observables are also discussed. We also present the results of a systematic study of the characteristics of the Δ excitation by ^{12}C, ^{14}N, ^{16}O and ^{20}Ne scattering. The cross section dependence with respect to projectile and ejectile is qualitatively understood. As observed in all other charge exchange reactions, the Δ peak on nuclei is shifted by ~ 70 MeV with respect to the free Δ.

39484 (IPNO-DRE–89-01) **Spin-isospin collective modes Δ in nuclei.** Roy-Stephan, M. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1989. 11p. Order Number DE89792004/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The charge-exchange reactions display the response of nuclei to a spin-isospin excitation. This response is concentrated in two excitation energy domains: - At low excitation energy, several particle-hole states contribute, the Gamow-Teller resonance and higher multipolarity spin-flip resonances. - Around 300 MeV, a nucleon from the target is excited into a Δ 1232 resonance. The strength in the Δ sector has the same order of magnitude as in the nuclear sector. The peak corresponding to Δ excitation in nuclei is energy shifted from the peak of the free Δ created in the reaction on hydrogen.

39485 (SAND–89-0902C) **Characterization of external ^{3}He ion beams used for ex-vacuo nuclear reaction analysis of deuterium.** Lee, S.R.; Walsh, D.S.; Doyle, B.L. Sandia National Labs., Albuquerque, NM (USA). 1989. 12p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8906161–1: Ion beam analysis conference, Kingston, Canada, 26-30 Jun 1989). Order Number DE89014021/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In-air D(^{3}He,p)^{4}He nuclear reaction analysis (NRA) using external ^{3}He ion beams is now routinely used to characterize deuterium in both fusion and fission reactor materials. The depth resolution, lateral resolution, and detection sensitivity attainable in these ex-vacuo analyses is influenced by the energy spread, the spatial divergence, and the nuclear reaction background produced by extraction of the ^{3}He ion beam through a suitable exit window foil and subsequent transmission of the beam through one or more millimeters of air to the target. In the present paper, the energy spatial distributions of ex-vacuo MeV^{3}He ion beams are measured for transmission distances in air of 0 to 15 mm. Exit windows made from both commercially produced foils (3.81 μm-thick Au/Al) and foils prepared in the laboratory (1.14 μm-thick Au/Al) by e-beam evaporation onto NaCl have been examined. The measured distributions are compared to TRIM simulations, and the resolution of in-air D(^{3}He,p)^{4}He NRA is assessed. Finally, interfering background nuclear reaction yields in air are measured as a function of ex-vacuo ^{3}He beam energy, and the resulting deuterium detection sensitivity is discussed. 9 refs., 5 figs.

6512 Nuclear Properties and Reactions, A=1-5, Experimental

39486 (INIS-mf–11480, pp. 25-26) **Nuclear reactions between light charged particles. Compilation of reaction cross-sections between the first five elements.** Feldbacher, R.; Flaschberger, R. Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik. Nov 1988. (In German). In *Annual report of the Institute for Theoretical Physics in Graz, Austria.* Order Number DE89631627/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

BERYLLIUM/nuclear reactions; BORON/nuclear reactions; HELIUM/nuclear reactions; HYDROGEN/nuclear reactions; LITHIUM/nuclear reactions; BERYLLIUM; BORON; COMPILED DATA; CROSS SECTIONS; HELIUM; HYDROGEN; LITHIUM; PROGRESS REPORT

6513 Nuclear Properties and Reactions, A=6-19, Experimental

Refer also to citation(s) 39421

39487 (DOE/ER/40004–T3) **Medium energy meson physics: Progress report, January 1–December 31, 1985.** Crowe, K.M. California Univ., Berkeley, CA (USA). Dept. of Physics. [1989]. 15p. Sponsored by DOE Energy Research. DOE Contract AS03-81ER40004. Order Number DE89014558/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper discusses the following topics: radiative pion capture; eta parameter in muon decay; pion scattering; muon fusion; and muon SR studies. (LSP)

39488 (JAERI-M–89-047) **Evaluation of neutron nuclear data of N-15.** Fukahori, Tokio. Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment. Apr 1989. 19p. (NEANDC(J)–136/U;INDC(JPN)–123/L). Order Number DE89013906/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI.

Nuclear data of N-15 have been evaluated in the energy range from 0.01 MeV to 20 MeV. The evaluated quantities are cross section, angular distributions and energy spectra of secondary neutrons, and γ-ray data. The evaluation was performed by fitting the multilevel Breit-Wigner formula to the experimental data of the total cross section below 5.5 MeV, and using the multistep statistical model above 5.5 MeV. For the calculation of the multistep statistical model, the optical model and the level density parameters were chosen so as to reproduce the experimental data of N-14. The results of present work are in good agreement with the experimental data of cross sections. They were compiled for JENDL-3 in the ENDF-5 format. 12 refs., 7 figs., 5 tabs.

39489 (JINR-R–1-88-412) **Some methodical problems concerning momentum measurement and event selection on carbon target from interactions in propane bubble chamber.** Kladnitskaya, E.N.; Sivoklokov, S.Yu. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy. 1988. 9p. (In Russian). Order Number DE89630730/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The influence of errors arising during momentum measurement in propane bubble chamber on momentum distribution shape is investigated taking as an example the distributions obtained in the Dubna variant of cascade model (DCM). It is shown that making allowance for measurement errors leads to distortion of distribution shape for secondary particle momenta of P_{lab}>4-5 GeV/c. The efficiency of criteria for selecting events on a carbon target among the events in propane is estimated by the events modeled by DCM. 4 refs.; 5 figs.; 3 tabs.

39490 (JINR-R–1-88-417) **Investigation of slow π^--meson capture by C, N, O nuclei in photoemulsion with three charged particle production.** Batusov, Yu.A.; Tret'yak, V.I.; Kostanashvili,

N.I.; Chernev, Kh.M. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1988. 8p. (In Russian). Order Number DE89630731/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to the journal Yad. Fiz.

Reactions of slow π^-capture by light (C,N,O) nuclei in photoemulsion with production of three charged particles and of three charged particles and one neutron were investigated. It is found that the reactions of production of three charged particles and one neutron on carbon are most probable among the considered reactions. The π^- ^{12}C->^{7}Li ^{3}H p n channel was analysed. On the basis of study of energy and angular distributions of secondary particles for this channel the qualitative agreement is obtained with the estimates performed under assumption that π^--capture on carbon occurs on (^{8}Be) cluster. 16 refs.; 4 figs.; 1 tab.

6514 Nuclear Properties and Reactions, A=20-38, Experimental

39491 (CRN-PN–88-05) **Test of complex effective interaction by folding analysis of ^{32}S elastic scattering on s-d shell nuclei.** Bilwes, B.; Bilwes, R.; Diaz, J.; Ferrero, J.L.; Pacheco, J.C.; Ruiz, J.A. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1988. 18p. Order Number DE89792007/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Experimental data of elastic scattering between nuclei of various structures on a large energy scale has been analyzed in the framework of the folding model by use of the complex effective interaction of Faessler et al (1981). A general good reproduction of the data is obtained if renormalization coefficients for the real and the imaginary parts of the optical potential are introduced. The application of the dispersion relation of Mahaux et al (1986) allows to reproduce the observed energy dependence of the real part of the potential.

39492 (INIS-mf–11467) **Central collisions between ^{28}Si nuclei at 12.4, 19.7 and 30.0 MeV per nucleon.** Meijer, R.J. Rijksuniversiteit Utrecht (Netherlands). 22 Mar 1989. 128p. Order Number DE89630734/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Includes list of acronyms; summary in Dutch.

The formation and decay of nuclei in central collisions of the ^{28}Si + ^{28}Si system at bombarding energies of 12.4, 19.7 and 30.0 MeV per nucleon is studied by analysis of the light particle (LP) spectra measured in coincidence with evaporation residues (ER) and measurements of the inclusive velocity distribution of ER's. From the last set of measurements a strong reduction of the ER cross section at increasing incident energy was observed and especially the relation to a possible vanishing fusion cross section is discussed. The coincidence measurements determines the LP pre-equilibrium contribution and the LP decay modes of highly excited systems. The ER's produced in fusion reactions between ^{28}Si nuclei were detected with a simple ionization chamber ΔE detector and a surface barrier E detector. For the LP detection multidetector systems consisting of CsI(TL) detectors were used. In this thesis the developments that have led to the construction of a CsI(TL) charged particle detector and of the Utrecht multidetector system, the experimental setup and the methods used in the acquisition, processing and analysis of the data, are described. The results of the heavy-ion velocity measurements are presented and conclusions are drawn about equilibrium and pre-equilibrium processes from the analysis. (H.W.). 124 refs.; 44 figs.; 24 tabs.

6515 Nuclear Properties and Reactions, A=39-58, Experimental

Refer also to citation(s) 39491

39493 (CRN-PN–88-35) **Threshold anomaly in the ^{32}S + ^{40}Ca interaction.** Bilwes, B.; Bilwes, R.; Diaz, J.; Ferrero, J.L.; Ruiz, J.A. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1988. 28p. Order Number DE89791986/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Angular distributions for elastic scattering of ^{32}S by ^{40}Ca, inelastic scattering leading to the first 2^+ state in ^{32}S and the first 3^- state in ^{40}Ca and one neutron stripping reactions have been measured at E_{lab} = 90 and 110 MeV. Angular distributions for alpha stripping reactions have been measured at E_{lab} = 90, 100 and 110 MeV. The data have been analyzed in terms of the double-folding model using the coupled-channel approximation for inelastic scattering. The energy dependence of the renormalization coefficient of the folding potential founded in a previous paper has been confirmed at these new energies and is consistent with the dispersion relation of Mahaux et al. [16,7]. The influence of the coupling of inelastic and transfer channels on the renormalization coefficient has been found to be important. The energy dependence of the potential diminishes with increasing coupling strength.

6516 Nuclear Properties and Reactions, A=59-89, Experimental

Refer also to citation(s) 39540

39494 (CRN-PN–88-37) **Two-proton transfer reactions on even Ni and Zn isotopes.** Boucenna, A.; Kraus, L.; Linck, I.; Tsan Ung Chan. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1988. 28p. Order Number DE89791985/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Two-proton transfer reactions induced by 112 MeV^{12}C ions on even Ni and Zn isotopes are found to be less selective than the analogous two-neutron transfer reactions induced on the same targets in a similar incident energy range. The additional collective aspects observed in the proton transfer are examined in view of a semiphenomenological model of two quasi-particles coupled to a triaxial asymmetric rotor. Tentative spin and parity assignments emerge from this comparison, from crude shell model calculations and from systematic trends.

39495 (DOE/ER/40481–3) **The status of the Soviet-American gallium solar neutrino experiment.** Gavrin, V.N.; Abazov, A.I.; Abdurashitov, D.N.; Bowles, T.J.; Cleveland, B.T.; Elliott, S.R.; Davis, R. Jr.; Lande, K.; Cherry, M.L.; Kouzes, R.T. SAGE Collaboration. Louisiana State Univ., Baton Rouge, LA (USA). Dept. of Physics and Astronomy. [1989]. 3p. Sponsored by DOE Energy Research. DOE Contract FG05-88ER40481. (CONF-8905187–1: WEIN '89, Montreal, Canada, May 1989). Order Number DE89014564/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A radiochemical ^{71}Ga–^{71}Ge experiment to determine the integral flux of neutrinos from the sun has been constructed at the Baksan Neutrino Observatory in the USSR. Measurements have begun with 30 tonnes of gallium. An additional 30 tonnes of gallium are being installed so as to perform the full experiment with a 60-tonne target. The motivation, experimental procedures, and present status of this experiment are described.

6517 Nuclear Properties and Reactions, A=90-149, Experimental

39496 (INIS-SU–78, pp. 317-321) **Average cross sections of radiation transition excitation of ^{112}Cd and ^{114}Cd in 10-15 keV neutron capture.** Konobaevskij, E.S. (AN SSSR, Moscow (USSR). Inst. Yadernykh Issledovanij); Mordovskij, M.V.; Popov, V.I.; Potashev, S.I.; Surkova, I.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

Excitation cross sections of several γ-transitions in (n,γ) reactions for ^{111}Cd and ^{113}Cd have been measured in the energy region 10-150 keV. Information on E1 radiation-strength functions for transitions to the ground and low-energy excited states of ^{112}Cd has been obtained. 3 refs.; 3 figs.; 2 tabs.

39497 (INIS-SU–78, pp. 334-337) **Temperature shift of neutron resonances.** Seidel, K. (Technische Univ., Dresden (German Democratic Republic)); Seeliger, D.; Ignatovich, V.K.; Meister, A.; Mittag, S.; Pilz, W. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow

(USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

In neutron transmission measurements in the low energy resonances region by neutron time-of-flight spectrometry temperature dependent shifts of the position of neutron resonances are observed. 6 refs.; 3 figs.

39498 (IPNO-DRE–88-22) **Excitation of giant resonances in ^{20}Ne + ^{90}Zr and ^{208}Pb inelastic scattering at 40 MeV/u[1].** Suomijaervi, T.; Beaumel, D.; Blumenfeld, Y.; Chomaz, P.; Frascaria, N.; Garron, J.P.; Jacmart, J.C.; Roynette, J.C.; Barrette, J.; Berthier, B. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1988. 36p. Order Number DE89792002/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The giant resonance region in the inelastic spectra from the reactions ^{20}Ne + ^{90}Zr and ^{20}Ne + ^{208}Pb at 40 MeV/nucleon has been studied with a good energy and angular resolutions. The strength distributions of the different multipolarities contributing to the cross section were obtained by a resonance shape independent analysis. In the case of ^{208}Pb the GDR strength was found to be strongly shifted towards lower excitation energies which can be explained by the exponentially decreasing Coulomb excitation probability. Furthermore, indications for a high multipolarity component in the resonance structure were found in both reactions.

39499 Picosecond lifetime measurements in ^{116,118,120}Cd and the structure of normal and intruder states. Mach, H. (Brookhaven National Laboratory, Upton, New York 11973(US)); Moszynski, M.; Casten, R. F.; Gill, R. L.; Brenner, D. S.; Winger, J. A.; Krips, W.; Wesselborg, C.; Buscher, M.; Wohn, F. K.; and others. *Physical Review Letters (USA),* 63(2): 143-146 (10 Jul 1989). DOE Contract FG02-88ER40417;AC02-76CH00016.

A new method of fast-timing measurements using β-γ-γ coincidences with BaF_2 and plastic detectors has been used to measure a number of lifetimes for low-lying states in ^{116,118,120}Cd in the range of 10–100 ps. The results are discussed in terms of the vibrational and intruder structure of these nuclei.

6518 Nuclear Properties and Reactions, A=150-189, Experimental

Refer also to citation(s) 39497

39500 (INIS-SU–78, pp. 204-208) **Investigation on the neutron interaction with radioactive ^{177}Lu and stable ^{175,176}Lu.** Vertebnyj, V.P. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij); Vorona, P.N.; Kal'chenko, A.I.; Krivenko, V.G.; Chervonnaya, L.E.; Chervyakov, V.Yu. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

The sample, containing radioactive Lu-177 was obtained by irradiating in the reactor flux. Burnup cross section σ (Lu-177g) was received; the possibility to observe the resonance structure of isomeric state Lu-177m2 is discussed. The resonance parameters for Lu-175,176 are listed up to 15 eV. 2 refs.; 1 fig.; 3 tabs.

39501 (INIS-SU–78, pp. 209-213) **Measurement of the isomer lutetium 177 ($T_{1/2}$=160.10 days) production cross section.** Gritaj, E.A. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

The reactor cross section was measured for formation of $^{177m(sub3}$Lu σ_m=(3.18±0.30))b with choice of the Westcott epithermal index $r\sqrt{T/T_0}$=0.10 and the isomer ratio σ_m/σ_g=(5.45±0.71)x10^{-4}. The yield of ^{177}Lu was determined by the activation method. 3 refs.; 1 fig.; 1 tab.

39502 (UJF–02/88) **Low-intensity gamma rays in the decay of ^{166}Ho.** Adam, J.; Fiser, M.; Kracik, B.; Wagner, V.; Zvolska, V.; Zvolsky, J. Ceskoslovenska Akademie Ved, Rez (Czechoslovakia). Ustav Jaderne Fyziky. Sep 1988. 13p. Order Number DE89630749/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Using an anti-Compton spectrometer, the gamma ray spectrum of ^{166m}Ho was remeasured with the aim to reveal new Low-intensity gamma transitions since ^{166m}Ho is a recommended calibration standard for Ge(Li) or HPGe detectors. Altogether, 61 gamma transitions were assigned to the ^{166m}Ho decay. All of them were established in the decay scheme. (author). 2 figs., 2 tabs., 16 refs.

6519 Nuclear Properties and Reactions, A=190-219, Experimental

Refer also to citation(s) 39498

39503 (GANIL-P–88-15) **Peripheral collisions in Ar induced reactions between 27 and 44 A.MeV: study of energy dissipation by measuring the correlated neutron multiplicities.** Guerreau, D.; Doubre, H.; Galin, J.; Pouthas, J.; Jahnke, U.; Jiang, D.X.; Charvet, J.L.; Morjean, M.; Magnago, C.; Patin, Y. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1988. 11p. (CONF-8809118–: 20. summer school on nuclear structure studies by means of nuclear reactions: heavy ions in nuclear and atomic physics, Mikolajki, Poland, 2-11 Sep 1988). Order Number DE89789263/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A 4 π detector measuring the neutron multiplicities has been used to investigate the energy dissipation during peripheral collisions in Ar induced reactions around the Fermi Energy. Besides the persistance of direct transfer reactions for the most peripheral collisions, there are strong evidences for the occurrence of quite large energy dissipation, a clear signature for the one body friction to still play a major role at these intermediate energies.

39504 Very-high-spin and core-coupled states in ^{213}Rn. A test of the applicability of the deformed independent particle model. Loennroth, T. (State Univ. of New York, Stony Brook (USA). Dept. of Physics); Beausang, C.W.; Fossan, D.B.; Hildingsson, L.; Piel, W.F. Jr.; Waburton, E.K. *Physica Scripta (Sweden),* 39(1): 56-65 (Jan 1989).

Excited states in ^{212,213}Rn were populated in the bombardment of ^{204}Hg by ^{14}C ions of energies 80-94 MeV. The depopulation of the excited states was studied using in-beam spectroscopic methods including γ-ray excitation, γ-ray angular distribution γ-γ-t coincidence, pulsed-beam-γ timing and conversion electron measurements. Spins up to J^π=30 Planck constant and a tentative J=(73/2) Planck constant were observed, respectively. In ^{212}Rn the previous level scheme was confirmed, with the addition of five new transitions of which one feeds the 30^+ state. In ^{213}Rn the previously reported level scheme was mainly confirmed and it was extended to (71/2) or (73/2) Planck constant, which is the highest spin observed to-date in a lead-region nucleus. Several transition rates B(λ) were deduced from isomeric half-lives or branching ratios in both isotopes. Deformed Independent Particle Model (DIPM) calculations were performed to assign configurations, which in ^{213}Rn usually consist of the odd neutrons $\nu g_9/2$ and $\nu j_{15}/2$ coupled to the four-proton states in ^{212}Rn. The highest levels include neutron core-excitations, since the maximum valence-nucleon angular momentum in ^{213}Rn is 55/2 Planck constant. The very topmost levels even need 2-particle-two-hole excitations. Shape changes in these two Rn isotopes are discussed, as are the transition rates. (orig.).

6520 Nuclear Properties and Reactions, A=220 and Above, Experimental

Refer also to citation(s) 39516

39505 (FRNC-TH-3313) **Impulse transfer and light particles emission during the reaction α + ^{232}Th at 70 MeV/u.** Nguyen, M.S. Paris-11 Univ., 91 - Orsay (France). Feb 1988. 260p. (In French). Order Number DE89791991/JAW. Available from NTIS (US Sales Only), PC A12/MF A01.

We have measured during the reaction ^{4}He + ^{232}Th at 70 MeV/u the angular correlation of heavy fragments of fission, the inclusive energy spectra of light particles (p, d, t, ^{3}He and α) and triple coincidence between two fission fragments and a light ejectile. Energy spectra show an evaporation component at low energy, a component of projectile fragmentation at energy equivalent to beam velocity and an intermediate component attributed to pre-equilibrium emission. The analysis of the correlation between linear momentum transfer to the fissioning nucleus and the characteristics of the ejectile in coincidence shows a phenomenon of incomplete massive transfer. We run an Intra-Nuclear Cascade (INC) computation to reproduce ejectile energy spectra, but the agreement with experiment was very bad. We conclude to the impossibility to apply INC computation at intermediate energy of 70 MeV/u. We also applied Distorted Wave Born Approximation (DWBA) for direct transfer reaction extended to continuum states: but the agreement with experiment was again deceiving. Finally, we used an analysis by moving sources for which we propose a model of generalized fragmentation giving a continuous representation of the emission source phenomenon from low energy up to high energy.

39506 (INDC(CCP)-298/L, pp. 63-70) **Cross-sections for the production of γ-rays by the interaction of 3.0 MeV neutrons with ^{232}Th, ^{236}U and ^{238}U nuclei.** Filatenkov, A.A.; Blinov, M.V.; Chubaev, S.V.; Saidgareev, V.M. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Apr 1989. In *Translation of selected papers published in Nuclear Constants 2, 1988.* Order Number DE89619041/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

Translated by the IAEA. Original report in Russian was distributed as INDC(CCP)-294/G.

Spectra and total cross-sections of γ-rays produced in the energy range 0.25-3.55 MeV by 3.0 MeV neutrons were measured. Substantial disagreement with the BNAB-78 evaluation was revealed. A large number of monochromatic γ-transitions were observed. About 20 γ-transitions are assigned to fission fragment prompt γ-rays. (author). 12 refs, 1 fig., 2 tabs.

39507 (INIS-SU-78, pp. 242-248) **Radiative capture cross section by ^{236}U and ^{238}U in the neutron energy range of 10 eV - 50 keV.** Adamchuk, Yu.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii); Voskanyan, M.A.; Muradyan, G.V.; Stepanov, V.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959--: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

Using the multiplicity spectrometry method the radiative capture cross sections of uranium 236 and uranium 238 were measured with the accuracy of 2-4%. The σ_γ values of uranium-238 at the energies of 2-50 keV turned out to be lower than the estimated data, which suggested the necessity of correction of the estimate in the direction of its reduction. The obtained σ_γ values of uranium 236 considerably improve the estimation accuracy. 10 refs.; 2 tabs.

39508 (JINR-E-15-88-573) **Study of the stability of the ground states and K-isomeric states of ^{250}Fm and ^{254}102 against spontaneous fission.** Lazarev, Yu.A.; Lobanov, Yu.V.; Sagajdak, R.N.; Utenkov, V.K.; Kharitonov, Yu.P.; Shirokovskij, I.V.; Tret'yakova, S.P.; Oganessyan, Yu.Ts.; Hussonnois, M. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions. 1988. 28p. Order Number DE89630755/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Submitted to the journal Phys. Scr.

By employing the ^{249}Cf(^{4}He, 3n) and ^{208}Pb(^{48}Ca,2n) reactions, experiments to study the stability against spontaneous fission of the nuclides ^{250}Fm and ^{254}102 as well as of the two-quasi-particle (2 q-p) K isomers ^{250}Fm ($T_{1/2}$=1,8±0,1 s) and ^{254}102 ($T_{1/2}$=0,28±0,04 s) have been performed. The groundstate spontaneous fission of the two nuclides has been discovered and the corresponding branching ratios b_{sf} and partial half-lives T_{sf}, respectively, have been determined to be: $(6,9\pm1,0)\times10^{-5}$, 0,83±0,15 yr for ^{250}Fm; $(1,7\pm0,5)\times10^{-3}$, $(3,2\pm0,9)\times10^{4}$ s for ^{254}102. As a by-product of these studies, new data about cross sections of the ^{206,208}Pb(^{48}Ca,xn) reactions have been obtained. Experiments designed to search for the spontaneous fission of the 2 q-p K-isometric states in ^{250}Fm and ^{254}102 have not revealed the effect in question. The lower limits of the ratios of the partial spontaneous fission half-lives for the 2 q-p K-isomeric states to those for the respective ground states, T^{*}_{sf}/T_{sf}, have been established to be $\geq10^{-1}$ for ^{250m}Fm/^{250}Fm and $\geq5\times10^{-3}$ for ^{254m}102/^{254}102. This means that the stability of the 2 q-p K-isomeric states in ^{250}Fm and ^{254}102 against spontaneous fission is practically not inferior to that of the ground states of these nuclei. In accord with the experimental findings, the theoretical estimates of T^{*}_{sf}/T_{sf} made in the present paper show that, due to the influence of the specialization and blocking effects on the potential energy and the effective mass associated with fission, spontaneous fission from 2 q-p K-isomeric states cannot be facilitated but, on the contrary, should be essentially hindered compared with ground-state spontaneous fission. 77 refs.; 4 figs.; 6 tabs.

39509 (LYCEN-T-8837) **Dimuons production study in 200 GeV/c p-U interactions. Comparison with ^{16}O-U results.** Alimi, O.M. Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire; Lyon-1 Univ., 69 - Villeurbanne (France). 1988. 72p. (In French). Order Number DE89792006/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

We present in this thesis the production of dimuons correlated with neutral transverse energy flow in 200 GeV/c p-U interactions. The highly intense beam ($\sim 5 \times 10^{7}$ particles per burst) with a thick target (20% interaction length) enabled us to acquire a large number of events ($\sim 6 \times 10^{4}$ dimuons) and required the use of adequate apparatus: the NA10 spectrometer for dimuon's detection, an electromagnetic calorimeter for the measurement of neutral energy, a fragmented active target for the determination of interaction vertex and various detectors for beam control. Details of the description and the performance of the active target are presented. Data analysis shows that the ratio J/psi's dimuon events to those of the continuum is independent of the neutral transverse energy. Identical procedure has been employed by the NA38 collaboration in treating data of ^{16}O-U interactions taken in similar situation. Results of the later shows a decrease of this ratio with increase in transverse energy, which is one of the proposed signals of the quark-gluon plasma. Negative results obtained in proton could be explained by the peculiar nature of the observed reaction.

6530 Nuclear Theory

Refer also to citation(s) 39439, 39645

39510 (BNL-42848) **Pseudorapidity distributions, nuclear stopping, and the failures and successes of the fireball model.** Tannenbaum, M.J. Brookhaven National Lab., Upton, NY (USA). May 1989. 6p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8903143--1: 24. Recontres de Moriond: new results in hadronic interactions, Les Arcs, France, 12-18 Mar 1989). Order Number DE89014516/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Pseudorapidity distributions of multiplicity and transverse energy are a useful probe of nuclear stopping. Emulsion results at the AGS and CERN, as well as E_T measurements at both laboratories are discussed, and show that the fireball model with crisp and precise predictions of the pseudorapidity distributions, utterly fails to reproduce the measurements. By stark contrast, the fireball model is very successful in predicting the observed ratio of E_T production in central ^{32}S and ^{16}O interactions in Au and other heavy targets. This conundrum is explored and explained, leading to a systematic comparison of measurements from all the RHI experiments at the AGS and CERN. 14 refs., 3 figs.

39511 (BNL-42975) **Empirical proton-neutron interaction strengths.** Casten, R.F.; Zhang, J.Y.; Brenner, D.S. Brookhaven

National Lab., Upton, NY (USA). 1989. 8p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8906168–1: International conference on selected topics in nuclear structure, Dubna (USSR), 20-24 Jun 1989). Order Number DE89015020/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

An empirical technique to extract proton-neutron interaction energies for specific protons and neutrons in a wide variety of nuclei is described. The results shed light on the roles of the monopole and quadrupole components of the p-n interaction, their orbit dependence, the microscopic basis of the N_pN_n scheme, and the saturation of collectively observed in deformed nuclei. 3 refs., 4 figs.

39512 (INDC(CCP)–298/L, pp. 47-51) **Use of evaluated nuclear data libraries for the calculation of kerma factors.** Bondarenko, I.M.; Zabrodskaya, A.S.; Krivtsov, A.S.; Nikolaev, I.N. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Apr 1989. In *Translation of selected papers published in Nuclear Constants 2, 1988.* Order Number DE89619041/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

Translated by the IAEA. Original report in Russian was distributed as INDC(CCP)-294/G.

A computational model is developed for calculating neutron kerma factors and total energy of protons from basic nuclear data for all neutron reaction types in any energy range. The evaluated nuclear data libraries are used for calculating the kerma factors. (author). 4 refs.

39513 (INDC(CCP)–298/L, pp. 5-19) **Calculation of integral delayed neutron properties. Part 1. Total neutron yield.** Manevich, L.G.; Nemirovskij, P.Eh.; Yudkevich, M.S. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Apr 1989. In *Translation of selected papers published in Nuclear Constants 2, 1988.* Order Number DE89619041/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

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The total delayed neutron yield was derived from nuclear data and the fission yields of the individual precursors. Agreement with experimental measurements is acceptable for the cases of 25 fissionable nuclides. (author). 20 refs, 4 tabs.

39514 (INDC(CCP)–298/L, pp. 21-36) **Calculation of integral delayed neutron properties. Part 2. Group constants and reactivity.** Manevich, L.G.; Nemirovskij, P.Eh.; Yudkevich, M.S. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Apr 1989. In *Translation of selected papers published in Nuclear Constants 2, 1988.* Order Number DE89619041/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

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Using the fission-product delayed neutron precursor data, six delayed neutron groups for six fissionable nuclides were obtained. Comparison with known sets of delayed neutron parameters was performed in terms of reactor kinetics calculations. (author). 12 refs, 3 figs, 5 tabs.

39515 (INDC(CCP)–298/L, pp. 37-45) **Uranium and plutonium energy release per fission event in a nuclear reactor.** Badalov, A.F.; Kopejkin, V.I. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Apr 1989. In *Translation of selected papers published in Nuclear Constants 2, 1988.* Order Number DE89619041/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

Translated by the IAEA. Original report in Russian was distributed as INDC(CCP)-294/G.

The total and effective (including all contributions except those from antineutrinos and long-lived fission products) energies per fission were calculated for the nuclides ^{235}U, ^{238}U, ^{239}Pu and ^{241}Pu. The total thermal energy, including that from neutron capture, was derived for a WWER-440 reactor. (author). 15 refs, 2 figs, 3 tabs.

39516 (INDC(CCP)–298/L, pp. 53-61) **Target properties and nuclear data.** Kornilov, N.V.; Goverdovskij, A.A. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Apr 1989. In *Translation of selected papers published in Nuclear Constants 2, 1988.* Order Number DE89619041/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

Translated by the IAEA. Original report in Russian was distributed as INDC(CCP)-294/G.

The influence of the properties of the target on nuclear data was shown. In the case of targets consisting of fissionable material, this influence was demonstrated in experiments involving fission cross-section, average number of neutrons, and prompt fission neutron spectrum. The experimental methods for determining certain corrections were analysed. The method of tritium density determination for a solid target used as neutron source was likewise demonstrated. (author). 10 refs, 4 figs.

39517 (INIS-mf–11440, pp. 30-31) **Collectivity of odd light Sr and Y isotopes.** Bucurescu, D. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering); Cata, G.; Cutoiu, D.; Ivascu, M.; Zamfir, N.V. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The odd isotopes Sr-77 to 83 and Y-79 to 85 are investigated within the interacting boson-fermion model. The model parameters, especially the exchange force term are discussed within a NpNn systematics. (authors).

39518 (INIS-mf–11440, pp. 33) **Rare earth's charge radii staggering in a model containg correlations between proton and neutron superfluids.** Bulboaca, I. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering); Dumitrescu, O.; Horoi, M. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The so-called DELTA r^2 puzzle is explained in the framework of a model containing global correlations between p and n superfluids. (authors).

39519 (INIS-mf–11440, pp. 61-62) **Nuclear Fermi energy surfaces.** Galeriu, D. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering); Bucurescu, D.; Ivascu, M.; Legrand, I. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Starting from experimental nuclear methods, Fermi energies are calculated for protons and neutrons. (authors).

39520 (INIS-mf–11440, pp. 65-66) **Resonant states for nonlocal potential.** Grama, C. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering); Grama, N.; Zamfirescu, I. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The resonant states for a potential having a nonlocal term and a local term are investigated. (authors).

39521 (INIS-mf–11440, pp. 18-19) **On the determination of the number of participants in relativistic nuclear collisions.** Besliu, C. (Bucharest Univ. (Romania)); Jipa, A. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Some considerations on the number of participants in relativistic nuclear collisions are presented. The model calculations are compared with experimental results for 10 collisions at the energy of 4.5 GeV/nucleon. A good agreement is observed. (authors).

39522 (INIS-mf–11440, pp. 69-70) **Some particularities of the mechanism of central interactions generated by Ne-22 in photographic emulsion.** Haiduc, M. (Centrul de Astronomie si Stiinte Spatiale, Bucharest, Romania); Nitu, R.; Anghelescu, D.; Vogel, A. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

A mechanism is suggested considering the protons formed by the total splitting out of the neon nucleus undergo several interactions because of the Coulombian effects. (authors).

39523 (INIS-mf–11440, pp. 73-74) **Observation of the 6.32 keV M1 transition in the decay of the short-lived ismeric states in In-112.** Ionescu-Bujor, M. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering); Iordachescu, A.; Ivanov, E.A.; Pascovici, G.; Plostinaru, D.; Sabaiduc, V. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

In pulsed beam experiments performed on the Cd-112 (d, 2n) In-112 reaction the 6.32 keV M1 transition deexciting a 5^+ level at 162.9 keV has been oberved in the decay of the short-lived isomeric states in In-112. (authors).

39524 (INIS-mf–11440, pp. 75-76) **Decay level scheme of the short-lived isomeric states in In-112.** Ionescu-Bujor, M. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering); Iordachescu, A.; Ivanov, E.A.; Pascovici, G.; Plostinaru, D.; Sabaiduc, V. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Pulsed beam experiments have been performed to investigate the properties of short-lived isomeric states in In-112 excited in the $^{109}Ag(\alpha,n)$ reaction. (authors).

39525 (INIS-mf–11440, pp. 80) **Fission inertia in terms of nuclear length, necking-in and mass asymmetry.** Mirea, M. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering); Ivascu, M.; Poenaru, D.N.; Greiner, W. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The variation of effective mass is analyzed in terms of three independent parameters which determine the nuclear shape. (authors).

39526 (INIS-mf–11440, pp. 103-104) **Nuclear level mixing resonances on oriented nuclei.** Stan-Sion, C. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering); Iacob, V.E.; Trache, L.; Iuga, I. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The angular distribution of gamma radiation emitted from oriented nuclei can show resonant signals under the influence of combined magnetic and electric quadrupole interactions as an intermediate state perturbation. (authors).

39527 (INIS-mf–11440, pp. 111-112) **E1 transition probabilities in the sdf-IBA model.** Zamfir, N.V. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering); Bucurescu, D.; Ivascu, M.; Brentano, P. von; Barfield, A.F.; Scholten, O. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

An E1 transitionoperator containing both a one-body and a two-body term is tested for experimental E1 values in Sm and Gd isotopes. (authors).

39528 (INIS-mf–11440, pp. 113-114) **E3 transitions in Sm isotopes in the IBA model.** Zamfir, N.V. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering); Bucurescu, D.; Ivascu, M.; Brentano, P. von. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The systematics of the B(E3) values for the 3^- states in Sm-144 to Sm-154 is considered within the sdf- IBA model. (authors).

39529 (INIS-mf–11440, pp. 107-108) **Semiclassical theory of the coupled-states for heavy atoms interaction.** Trisca, I. (Institutul de Tehnologie Izotopica si Moleculara, Cluj-Napoca (Romania)); Romantan, A.; Brandus, I. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The semiclassical theory of the coupled-states is adapted for inelastic collisions in heavy atom systems. (authors).

39530 (INIS-mf–11440, pp. 232-233) **Relative population for heavy atoms system in thermodynamic equilibrium.** Romantan, A. (Institutul de Tehnologie Izotopica si Moleculara, Cluj-Napoca (Romania)); Trisca, I.; Roscau, R. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The calcules and results for the relative population for the neutral U atoms in the thermodynamic equilibrium between 2300-2800 K are presented. (authors).

39531 (INIS-SU–78, pp. 9-12) **Microscopic approach to the description of neutron and radiative strength functions of atomic nuclei.** Voronov, V.V. (Joint Inst. for Nuclear Research, Dubna (USSR)); Zhuravlev, I.P. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

The general expression for optical transmission of a nuclear taking into account the microscopic structure of the states is obtained on the basis of general formulas of scattering theory and Feshbach's projection operator treatment. The nuclear structure is treated on the basis of quasiparticle-phonon nuclear model. Neutron strength functions of some nuceli are calculated. The radiative strength function of ^{106}Pd and ^{144}Nd are studied. 12 refs.; 2 tabs.

39532 (INIS-SU–78, pp. 41-52) **Fermi energy anomaly in the nucleon-nucleus potential.** Finlay, R.W. (Ohio Univ., Athens (USA)). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

Careful comparisons of the parameters of the nucleon-nucleus optical potential at energy ($E<10$ MeV) with those at higher energies ($E>20$ MeV) have revealed discrepancies. Commonly used "global optical models" tend to fail in one energy region or the other. Improved agreement with the data can be restored in phenomenological models in which certain geometrical parameters of the model are allowed to depend explicitly on neutron energy. The origin of this effect in the $n+^{208}Pb$ system has been explained in terms of the dispersion correction to the real part of the standard local optical potential. In dispersion theory, the magnitude of this correction is obtained from the energy dependence of the phenomenological imaginary potential. The phenomenological parameters for n and p on ^{208}Pb are re-examined. The dispersion theory explanation of the low energy behaviour of the neutron potential is supported by the

present analysis, but no similar analyses suggest that the Fermi energy anomaly for the p+^{208}Pb potential is located at energies well below the Coulomb barrier. 26 refs.; 6 figs.

39533 (INIS-SU–78, pp. 87-95) **Statistical multistep direct and compound processes below 30 MeV for niobium-93.** Kalka, H. (Technische Univ., Dresden (German Democratic Republic)); Seeliger, D.; Zhivopistsev, F.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

A simple reaction model for statistical multistep direct processes including quasiparticle and phonon excitations is presented and tested on ^{93}Nb and (n,p) at incident energies between 5 and 26 MeV. 12 refs.; 3 figs.

39534 (INIS-SU–78, pp. 3-8) **Comparison of deformed nucleus description within quasiparticle-phonon and interacting boson models.** Solov'ev, V.G. (Joint Inst. for Nuclear Research, Dubna (USSR)). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

The quasiparticle-phonon nuclear model is compared with the interacting boson model. It is shown that there are essential difference in the basic assumptions of the models and in the description of states of deformed nuclei with $K_n^{\pi}=O_2^-$, $O_3^{\pm}$, $0_4^{\pm}$, $1_2^{\pm}$, $1_3^{\pm}$, $2_2^{\pm}$, $2_3^{\pm}$, $2_4^{\pm}$, $3_2^{\pm}$, $3_3^{\pm}$, 4_1^+ and 4_2^+. 7 refs.

39535 (INIS-SU–78, pp. 107-115) **New set of one-fermion level density parameters.** Capote, R. (Academia de Ciencias de Cuba, La Habana (Cuba)); Herrera, E.; Lopez, R.; Osorio, V.; Kabin, E. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

A new set of level density parameters a_1 and D_1 for nuclei with mass number $40 < A < 249$ were obtained. Calculations using different parametrizations were compared with experimental data. A good agreement was achieved. 7 refs.; 4 figs.; 1 tab.

39536 (INIS-SU–78, pp. 160-164) **Specific features of optical potential extrapolation on the low energy region in the optical-statistical analysis of neutron cross sections for nuclei of structural elements.** Kon'shin, O.V. (Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR)). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

Influence of the Fermi surface anomaly on the optical model parametrization is discussed. The effect of an anomaly in the Fermi energy region on the choice of optical potential parameters is considered. The nuclei of ^{51}V, ^{52}Cr, ^{56}Fe, ^{58}Ni, ^{93}Nb, ^{100}Mo, ^{208}Pb are analyzed. All calculations are performed within the framework of Hauser-Feshbach-Modauer formalism, the contribution of direct process is taken into account by the coupled channel method. 8 refs.; 2 figs.

39537 (INIS-SU–78, pp. 166) **Energy dependent Breit-Wigner model for the E1 gamma-ray strength function in the mass region $50 \leq A \leq 90$.** Avrigeanu, M.; Ivascu, M.; Brandus, I.; Cata, G.; Avrigeanu, V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

INTERMEDIATE MASS NUCLEI/gamma radiation; BREIT-WIGNER FORMULA; ENERGY DEPENDENCE; E1-TRANSITIONS; GIANT RESONANCE; LINE WIDTHS; STRENGTH FUNCTIONS

39538 (INIS-SU–78, pp. 166) **Cross section calculations for fast neutron interactions with iron isotopes.** Avrigeanu, M.; Ivascu, M.; Avrigeanu, V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

IRON 54 TARGET/neutron reactions; IRON 56 TARGET/neutron reactions; NEUTRON REACTIONS/cross sections; FAST NEUTRONS; HAUSER-FESHBACH THEORY; DECAY; NUCLEAR FRAGMENTS; PRECOMPOUND-NUCLEUS EMISSION

39539 (INIS-SU–78, pp. 254-257) **Analysis of average neutron parameters in 3p resonance region by means of spherical optical model.** Kuznetsova, L.V. (Joint Inst. for Nuclear Research, Dubna (USSR)); Popov, A.B.; Samosvat, G.S. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, Kiev, USSR, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

Neutron strength functions and scattering radii for s- and p-wave obtained from average differential elastic scattering cross sections are analysed with the help of the nuclear optical model with spherical potential for nuclear masses in the range $A \sim 50\text{-}140$. 9 refs.; 3 figs.

39540 (ISN–87-89) **Identification and structure of p-rich rare-earth nuclei investigated using a He-jet fed on-line mass-separator.** Beraud, R.; Charvet, A.; Duffait, R.; Emsallem, A.; Redon, N.; Rolando-Eugio, D.; Genevey, J.; Gizon, A. Meyer, M. Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires. 1987. 10p. (CONF-8709440–: 5. International conference on nuclei far from stability, Rosseau Lake, CA, USA, 14-19 Sep 1987). Order Number DE89789230/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

Activities produced via fusion-evaporation reactions with ^{32}S, ^{35}Cl and ^{36}Ar beams in thin ^{112}Sn and ^{106}Cd targets have been transported using a He-jet coupled to a mass separator. Gamma-ray and X-ray techniques have been used to study the excited levels of ^{138}Sm, ^{136}Sm and ^{134}Nd, ^{132}Nd fed in the β-decay of ^{138}Eu(12 s), ^{136}Eu(3.7 s), ^{134}Pm (21 s) and ^{132}Pm (5 s). Results are presented through systematics and discussed in the framework of recent self-consistent calculations including the γ degree of freedom.

39541 Simple systematics of the shape transitions in hot rare-earth nuclei. Alhassid, Y. (Center for Theoretical Physics, Sloane Laboratory, Yale University, New Haven, Connecticut 06511(US)); Manoyan, J. M.; Levit, S. *Physical Review Letters (USA)*, 63(1): 31-34 (3 Jul 1989).

The Landau theory of shape transitions in hot rotating nuclei is applied to even-even rare-earth nuclei from cerium to hafnium. The parameters of the Landau expansion are extracted from microscopic calculations based on the Nilsson-Strutinsky procedure, and are shown to follow simple systematics. In particular, the systematics of the critical temperature and the critical angular momentum of the shape transitions as functions of neutron and proton number are investigated. Simple rules are provided for the behavior of these quantities.

39542 Quark-matter droplets in high-energy nuclear collisions. Seibert, D. (School of Physics and Astronomy, University of

Minnesota, Minneapolis, Minnesota 55455(US)). *Physical Review Letters (USA)*, 63(2): 136-138 (10 Jul 1989).

We explain "intermittency" in recent data, using a simple model in which pions are emitted from quark-gluon-plasma droplets. We find that droplets with a temperature near the QCD phase transition temperature that emit 10–15 pions, with a droplet volume of 5–10 fm^3, reproduce the observations very well.

6540 Radiation and Shielding Physics

Refer also to citation(s) 38386, 38965, 39023, 39106

39543 (CONF-890844–1) **Performance of a parallel algorithm for solving the neutron diffusion equation on the hypercube.** Kirk, B.L.; Azmy, Y.Y. Oak Ridge National Lab., TN (USA). 1989. 19p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From 18. international conference on parallel processing; Chicago, IL, USA; 8-12 Aug 1989. Order Number DE89006128/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The one-group, steady state neutron diffusion equation in two- dimensional Cartesian geometry is solved using the nodal method technique. By decoupling sets of equations representing the neutron current continuity along the length of rows and columns of computational cells a new iterative algorithm is derived that is more suitable to solving large practical problems. This algorithm is highly parallelizable and is implemented on the Intel iPSC/2 hypercube in three versions which differ essentially in the total size of communicated data. Even though speedup was achieved, the efficiency is very low when many processors are used leading to the conclusion that the hypercube is not as well suited for this algorithm as shared memory machines. 10 refs., 1 fig., 3 tabs.

39544 (RAL–89-016) **Deep inelastic neutron scattering.** Mayers, J. Rutherford Appleton Lab., Chilton (UK). Mar 1989. 35p. Order Number DE89630681/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The report is based on an invited talk given at a conference on "Neutron Scattering at ISIS: Recent Highlights in Condensed Matter Research", which was held in Rome, 1988, and is intended as an introduction to the techniques of Deep Inelastic Neutron Scattering. The subject is discussed under the following topic headings:- the impulse approximation I.A., scaling behaviour, kinematical consequences of energy and momentum conservation, examples of measurements, derivation of the I.A., the I.A. in a harmonic system, and validity of the I.A. in neutron scattering. (U.K.).

6550 Medical Physics

Refer also to citation(s) 38118, 39295, 39300

39545 (EUR–11867) **Investigation of radiation protection instruments based on tissue-equivalent proportional counters. Results of a Eurados intercomparison.** Dietze, G.; Kluge, H.; Schuhmacher, H.; Edwards, A.A.; Guldbakke, S.; Leroux, J.B.; Lindborg, L.; Menzel, H.G.; Nguyen, V.D.; Schmitz, T. Commission of the European Communities, Luxembourg (Luxembourg). 1988. 36p. Available from NTIS (US Sales Only), PC A03/MF A01.

The dose-equivalent quantities which are recommended in radiation protection for environmental monitoring of penetrating radiation from external sources, are defined as the dose equivalents at specified points in the 30 cm diameter, tissue-equivalent ICRU sphere (ICRU, 1985). For area monitoring, the dose equivalent in 10 mm depth in the ICRU sphere, the ambient dose equivalent, H*(10), is suggested. In the case of neutron radiation, the appropriate calibration quantity is the neutron fluence PHI. The neutron fluence to ambient dose-equivalent conversion factor, hPHI = H*(10)/PHI, is a complicated function of the neutron energy reflecting the energy dependence of the kerma factor, the quality factor and the radiation transport in the ICRU sphere. An ideal dose-equivalent meter for neutrons should be sufficiently sensitive and should have a reading, M, so that the fluence response, M/PHI, is identical to the conversion factor, hPHI, over the entire range of neutron energies encountered in practice, i.e. from thermal neutrons to at least 15 MeVΘ. However, neutron monitors currently in use clearly fail to meet these requirements. The operational quantity, H*(10), is recommended by the ICRU as an estimator for the effective dose equivalent, H_{eff}, for penetrating radiations. The depth of 10 mm was chosen as a compromise between the appropriate neutron energy dependence and sufficient sensitivity for photons below 50 keV.

39546 (GR-A–88-05, pp. 13-26) **Effective dose equivalent. Measure for radiation risks?.** Huyskens, C.J. (Technische Univ. Eindhoven (Netherlands)); Passchier, W.F. Gezondheidsraad, The Hague (Netherlands). 1 Aug 1988. (In Dutch). In *Ionizing radiation. From effects to protection.* Available from library KNAW, P.O. Box 41950, 1009 DD Amsterdam, Netherlands.

The effective dose equivalent is a quantity which is used in the daily practice of radiation protection as well as in the radiation hygienic rules as measure for the health risks. In this contribution it is worked out upon which assumptions this quantity is based and in which cases the effective dose equivalent can be used more or less well. (H.W.).

39547 (INIS-mf–11440, pp. 637-638) **EDAN2D - a doses evaluation computational code.** Oprea, I. (Institutul de Reactori Nucleari Energetici, Pitesti (Romania)); Musat, D.; Patrascu, D. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

A computer code to evaluate the atmospheric dispersion the internal organs dosis is based on Gaussian model in cases of radioactive products release. (authors).

39548 (INIS-mf–11440, pp. 641-642) **Dosimetric evaluation on measurements of marine radioactivity.** Patrascu, V. (Institutul de Reactori Nucleari Energetici, Pitesti (Romania)); Bologa, A. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The results of evaluations show small doses for sea water imersion (100 h) and for fishes or intervertebrates ingestion. (authors).

39549 (INIS-mf–11440, pp. 645-646) **NEPTUN - computer code for man doses transmised by food with aquatic origin having isotopic charging consumption.** Patrascu, V. (Institutul de Reactori Nucleari Energetici, Pitesti (Romania)); Oprea, I. Central Inst. of Physics, Bucharest (Romania). 1988. (In Romanian). (CONF-8810372–: Advances in physics, Constanta, Romania, 6-8 Oct 1988). In *Advances in Physics.* Order Number DE89012158/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The code is implemented on CYBER computer and calculates doses transmision by food consumption with aquatic origin. (authors).

39550 (INIS-mf–11457(v.1,2) v. 1) **Consequences of the latest ICRP recommendations on a revision of publication 24.** Jammet, H. (Institut de Protection et de Surete Nucleaire, FonR); Coulon, R. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

In 1976, ICRP issued its publication n. 24, entitled 'Radiation Protection in uranium and other mines' which discusses the principles of protection of uranium miners and the methods of application of these principles. Since 1976, ICRP has published new recommendations, notably: in its Publication 26, which deals with new general principles of radiation protection; in Publication 32, where new values for the dose limits related to inhalation of ^{222}Rn decay products are recommended; in Publication 35, which discusses the general principles of monitoring for workers; in Publication 37, which treats in a detailed way the cost-benefit analysis procedure to be applied when optimizing the level of protection. In view of the particular importance of uranium mining in the nuclear fuel cycle, the ICRP has

found it necessary to undertake a revision of Publication 24. In this document, new limits, such as the secondary limit of 0.02 joule for the potential alpha energy intake of ^{222}Rn decay products in a year, are introduced as well as guidance on how the level of protection can be optimized.

39551 (INIS-mf–11457(v.1,2) v. 1) **Industry viewpoint.** Aspin, Norman. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The Canadian Mining industry view on dose limits is presented. The current limit of 4 WLM/year is deemed to be safe and a move toward a 0.7 WLM/year is criticized as overregulation. Significance of ALARA is questioned.

39552 (INIS-mf–11457(v.1,2) v. 1) **Labour viewpoint.** Williams, L.R. (United Steel Workers of America (USA)). Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The labour viewpoint in uranium miner protection is addressed. The current dose limit of 4 WLM/year is deemed too high. A tripartite committee including government, management and labour is proposed to review the dose limit.

39553 (INIS-mf–11457(v.1,2) v. 1) **Regulatory viewpoint.** Smythe, W.D. Canadian Nuclear Association, Toronto, ON (Canada); Atomic Energy Control Board, Ottawa, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The Atomic Energy Control Board has been responsible for radiation occupational health and safety in uranium mines since the introduction of the Atomic Energy Control Act in 1946. It is only in the last 9 years however that the Board has moved to fully exercise this responsibility. During this period the Board has developed a comprehensive licensing system and recently published draft uranium mining regulations. The new regulations (details not given) are an expression of the regulatory viewpoint. They reflect the operating philosophy of the Board, its relationships with industry and labour and its attitude towards the role of regulations in occupational health and safety. The Board believes that the new regulations are a reasonable compromise between the various viewpoints of industry and labour put forth during the drafting and public comment stages. It is also recognizes that one impact of the regulations will be additional cost to industry, but believes that it is a reasonable cost.

39554 (INIS-mf–11457(v.1,2) v. 1) **Are the current does limits for uranium miners too high?.** Wright, M.J. (United Steel Workers of America (USA)); Gerard, L.W.; Kanabe, A.; Seguin, H.; Vance, E. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The current Canadian dose limit for uranium miners is 4 WLM/yr. Recently, the Atomic Energy Control Board proposed a new limit of 50 mSv/yr. The setting of appropriate dose limits involves both risk estimation and public policy considerations. Varying estimates of the risk of radiation-induced respiratory cancer among uranium miners are examined. These estimates indicate a high risk of cancer among miners exposed at the current and proposed dose limits. Several arguments against lowering the dose limits are considered. The authors recommend a substantial lowering of dose limits, limited only by questions of feasibility. A tripartite committee should be established to examine the question of feasibility and recommend appropriate dose limits to the Board.

39555 (INIS-mf–11457(v.1,2) v. 1) **Derived surface contamination limits for the uranium mining and milling industry.** Ching, S.H. (Atomic Energy Control Board, Ottawa, ON (Canada)). Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Derived Surface Contamination Limits (DSCL), expressed as beta activity, are proposed for the control of surface contamination at the work place for the uranium mining and milling industry. They have been derived by a method incorporating recent ICRP recommendations and consideration of the radiation exposure pathways of ingestion, inhalation and external irradiation of the basal layer of skin. A generalized DSCL of 10^5 Bq/m^2 of beta activity is recommended for all contaminants likely to be found in uranium mine and mill workplaces except for fresh uranium concentrates. In the latter case, the DSCL is expressed in terms of alpha activity because the ratio of beta to alpha activities for fresh uranium concentrates is variable, the beta activity increases with the ingrowth of U-238 daughter products (Th-234 and Pa-234m) until secular equilibrium is re-established in about six months. Contamination of the order of the limiting value will be clearly visible on a contrasting surface and compliance with the DSCL would be a simple matter of removing all visible uranium concentrate from the surface.

39556 (INIS-mf–11457(v.1,2) v. 1) **Problems in setting and applying limits for occupational exposure to radon daughters.** Bush, W.R. (Atomic Energy Control Board, Ottawa, ON (Canada)). Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The problems in setting and applying a limit for exposure to radon daughters in uranium mines include: problems in setting a limit that is equivalent in risk to the 50 mSv limit on effective dose equivalent, taking into account the uncertainties in both the epidemiological data and the dosimetric calculations, and problems in applying the limit, taking into account concurrent exposure to other significant sources of radiation encountered in uranium mines. The Atomic Energy Control Board proposed regulatory amendments in 1983 which included a solution to the above problems based on the recommendations of ICRP-32, but is currently reconsidering the matter in light of comments received during the public consultation process. Alternative approaches are discussed, although the final regulatory position has yet to be decided.

39557 (INIS-mf–11457(v.1,2) v. 1) **There's something rotten in radon carcinogenesis epidemiology.** Cohen, B.L. Canadian Nuclear Association, Toronto, ON (Canada); Pittsburgh Univ., PA (USA). Dept. of Physics. 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

It is shown that the cancer risk from radon exposure as determined from miner data is completely inconsistent with the data on environmental radon, over predicting the risk by at least one or two orders of magnitude. This discrepancy is real, it is very large, and it cannot be ignored. It means either that most of the lung cancer among miners is due to causes other than radon, or that the linear-no threshold dose-response relationship for radiation carcinogensis seriously over-predicts risks at low doses even for alpha particles. For the Swedish miners, whose exposures were essentially in the environmental dose region, the former explanation is required.

39558 (INIS-mf–11457(v.1,2) v. 1) **Pilot ALARA analysis applied to dose reduction in an underground uranium mine.** Lowe, L.M. (Senes Consultants, Willowdale, ON (Canada)); Chambers, D.B.; Chakravatti, J.L.; Lahoux, D.; Black, K.; Culver, K. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The study focusses on the reduction of exposure to radon (and thoron) daughters by increased mine ventilation. The increased costs of ventilation are compared to potential collective dose reductions, both for specific worker categories and for the entire underground mining population. The resultant 'alphas' (incremental cost/dose saved) are compared to published values from radiation and other occupational protection sources. Data requirements for doing the ALARA analysis and the findings of the preliminary study are discussed in this paper.

39559 (INIS-mf–11457(v.1,2) v. 1) **Radiation safety aspects of occupational areas at a Brazilian open-pit mine.** Carvalho, S.M. (Instituto de Radioprotecao e Dosimetria, Rio de Janeiro, RJ (Brazil)); Mouco, C.L.; Estrada, J.S.; Ney, C.V. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

This paper discusses the radiation safety aspects of open-pit mining in Brazil and presents results of exposure rate measurements at points located at different work-front sites, primary crushing, static leaching sites and ore storage patio. Results of surface contamination and air monitoring in the hauling trucks and area control cabs are presented. Routine difficulties in trying to comply with the radiation safety procedures required is discussed and suggestions presented.

39560 (INIS-mf–11457(v.1,2) v. 1) **Radiation protection at a high grade uranium mine.** Meadley, T. (Amok Ltd., Saskatoon, SK (Canada)); Bundy, K.; Schidlowsky, W. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Since early 1980, Amok Ltd., on behalf of Cluff Mining has been operating uranium mining and milling facilities at Cluff Lake, Saskatchewan. Initial operations have been concerned with the extraction and processing of material from the D orebody that average 7% uranium. In approaching this project the company undertook a number of innovative programs in the area of radiation protection. Experience has shown the validity of these programs and areas in which additional programs are required. Results of the monitoring program have shown that mining and milling of ore from a high grade orebody is practical within the current federal and provincial regulatory limits on radiation dose. 4 figures.

39561 (INIS-mf–11457(v.1,2) v. 1) **Study of the dose conversion factors for inhalation risk assessment from radon daughters in mine atmosphere.** Subba Ramu, M.C. (Bhabha Atomic Research Centre, Bombay (India). Air Monitoring Section); Vohra, K.G. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The dose conversion factors estimated by various investigators vary from 0.2 to 18 rads $(WLM)^{-1}$. The same estimated by us taking into consideration the hygroscopic nature of the carrier aerosol and the unattached fraction of Ra A in uranium mines, and the energy dependent regional tissue masses in the T-B region of the lung is 0.92 rad $(WLM)^{-1}$. Based on these estimations and the dose equivalent limits for both stochastic and non-stochastic effects, the allowable radon exposure values for uranium mine workers have been computed. An appropriate value of 0.3 as the modification factor for rad to rem conversion based on epidemiological results of lung cancer occurrence amongst uranium mine workers has been found.

39562 (INIS-mf–11457(v.1,2) v. 1) **United States uranium registry: latest in a series of United States tissue donation programs.** Moore, R.H. (United States Uranium Registry, Richland, WA (USA)). Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The United States Uranium Registry, funded by the United States Department of Energy, was established in 1978. The objective of the program is to obtain voluntary premortem commitment for postmortem tissue donation. Analysis of this donated tissue should (1) identify the nature and distribution, if any, of uranium in the tissues, (2) evaluate the adequacy of current (and past) health protection programs, and (3) test the appropriateness of current regulations. Enrollment results of this and previous programs are outlined.

39563 (INIS-mf–11457(v.1,2) v. 1) **Uranium measurements in urine.** Napier, W.A. (Atomic Energy Control Board, Ottawa, ON (Canada)); Smart, B.C. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

This paper describes the purpose of the uranium in urine programs presently instituted at Canadian uranium mills. The role and responsibility of the Atomic Energy Control Board, the regulatory authority, is explained. A description of the current sampling strategy at each of the five operating mills is provided. The sampling strategy description includes the job-related sampling of mill workers, the frequency of sampling, the time of voiding and the administrative controls used to investigate high results. At each uranium mill the annual urine results for mill operators and mine maintenance personnel during the years 1982 and 1983 are reviewed. It is shown that the majority of the urine results are below the 15 μg/L value. The statistical test, Ridit Analysis is performed to determine whether a significant difference between the 1982 and 1983 workers' urine results at each mine. The Ridit statistic provides a measure of odds of receiving a higher result in 1983 when compared to 1982. Linear and convilinear regression techniques are used to show the relationship between frequency of the year's urine results for the two job occupations examined. Both Ridit Analysis and the regression techniques are suitable means of comparing urine data for trend analysis.

39564 (INIS-mf–11457(v.1,2) v. 1) **Comparing personal alpha dosimetry with the conventional area monitoring-time weighting methods of exposure estimation. A Canadian assessment.** Viljoen, J. (Atomic Energy Control Board, Ottawa, ON (Canada)); Balint, A.B. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

An experimental personal alpha dosimetry program for monitoring exposures of uranium mining facility workers in Canada is presently underway. All licensed operating mining facilities are participating. Dosimetry techniques, description of dosimeters being used by licensees, performance and problems associated with the implementation of the programme as well as technical and administrative advantages and difficulties experienced are discussed. Area monitoring-time weighting methods used and results obtained to

determine individual radon and thoron daughter exposure and exposure results generated by using dosimeters are assessed and compared.

39565 (INIS-mf–11457(v.1,2) v. 1) **Radon transport into underground openings.** Holub, R.F. (Bureau of Mines, Denver, CO (USA)). Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Bureau of Mines of the U.S. Department of Interior completed a study on radon transport. Steady state equations including both diffusion and forced flow satisfactorily describe the process of transport in porous media. If the equations are used in laboratory experiments, permeability, diffusion coefficient, porosity and tortuosity for a core sample can be obtained. For large underground openings (mines) a description consisting of matrix and fracture components can be used. It contains diffusion and forced flow component that, in the first approximation, move independently of each other. The results of these calculations are useful for radon control and mine design.

39566 (INIS-mf–11457(v.1,2) v. 1) **Radiation monitoring program in Italian non-uranium mines.** Sciocchetti, G. (ENEA, Rome (Italy)); Scacco, F.; Baldassini, P.G.; Sarao, R. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

A national monitoring program has been designed and experimentally tested by technical agency ENEA to meet the following objectives: to test periodically a large number of underground non-uranium mines; to advise the competent authorities for planning control procedures and remedial actions, if needed. The radiological characteristics of each mine were outlined by means of a control schema based on the monitoring of different working areas and the radon flux rate at the fan station of the surveyed mines. The investigation indicates that data from passive area monitoring may be sufficient to decide on appropriate countermeasures (mainly the implementation of the ventilation system) to meet the radioprotection requirements in non-uranium underground mines.

39567 (INIS-mf–11457(v.1,2) v. 1) **Inherent dosimetric and epidemiological uncertainties associated with lung cancer risk assessment for mining populations.** Steinhausler, F. (Salzburg Univ. (Austria). Inst. fuer Allgemeine Biologie, Biochemie und Biophysik); Hofmann, W. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Decisions on occupational dose limitations for miners require the quantification of the lung cancer risk due to inhaled radon daughters, together with its uncertainties. The present risk assessment by the ICRP uses the combined dosimetric and epidemiological approach. Both procedures are associated with significant problems either due to methodological uncertainties, or insufficient demoscopical and physiological data and information on past exposure history. In the presentation the resulting total uncertainty due to the combination of all uncertainties is calculated for the absolute and relative risk concept and applied to the USSR and CSSR uranium miner populations. The results indicate that in view of the questionable accuracy of the input data considerable caution must be exercised in the interpretation of any claim for a potential lung cancer risk at exposure levels below 100 WLM.

39568 (INIS-mf–11457(v.1,2) v. 1) **Study of mortality of Ontario miners.** Muller, J. (Ontario Ministry of Labour (Canada)); Kusiak, R.; Wheeler, W.C.; Suranyi, G.; Gentleman, J.F. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The mortality of cause of Ontario miners over the period 1955-1977 has been studied. The period of follow up was extended in uranium miners to the end of 1981. An increased risk of lung cancer was detected in gold miners and uranium miners. The cause for the increased lung cancer risk in gold miners is being investigated. Data on the relation between exposure to the short lived daughters of Radon-222 and lung cancer risk are given.

39569 (INIS-mf–11457(v.1,2) v. 1) **Present state of an epidemiological study of uranium miners in France.** Tirmarche, M (Centre d'Etude sur l'Evaluation de la Protection dans le Domaine Nucleaire, 92 - Fontenay-aux-Roses (France)); Brenot, J.; Piechowski, J.; Pradel, J.; Chameaud, J. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

A collaborative effort of the (IPSN), Institut de Protection et de Surete Nucleaire (CEA) and the medical staff of the mines, Compagnie Beneralo des Matieres Nucleaires (COGEMA) made possible the start of an epidemiological study of the uranium miners in France. At the present stage of the study an important part of the dosimetric information and the death statistics of the miners, having experienced for at least three months of underground mining during the period 1947-1972, have been collected. The data need more verification before being analysed. Even though 25% of the death causes are still unknown, an excess of mortality by lung cancer appears in this cohort.

39570 (INIS-mf–11457(v.1,2) v. 1) **Lung cancer induction by radon daughters in rats.** Chameaud, J. (COGEMA, Razes (France). Lab. de Pathologie Pulmonaire Experimentale); Masse, R.; Morin, M.; Lafuma, J. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Lung cancer induction was studied in a group of 2.400 rats exposed to radon daughters between 20 and 50 WLM. The dosimetry was carried out with an active track dosemeter measuring total potential alpha energy in a subgroup of 600 control and 1.000 exposed rats. Determination of equilibrium factors for different conditions of exposure allowed to reassess the doses to a former 800 rat subgroup. The updated results suggest a linear no-threshold relationship for lung cancer induction between 0 and 50 WLM. The doubling dose for cancer induction in the group was 20 WLM.

39571 (INIS-mf–11457(v.1,2) v. 1) **Mortality experience among workers in the uranium industry.** Nair, R.C. (Ottawa Univ., ON (Canada)); Abbatt, J.D.; Newcombe, H.B.; Frost, S.E.; Howe, G.R. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

A retrospective cohort study of the employees of Eldorado Resources Limited is being conducted. The workers were employed at two uranium mines, a radium and uranium refinery and several service groups. This preliminary report examines the mortality experience of 18,424 male workers between 1950 and 1980. Both mining camps showed increased mortality due to lung cancer and external causes. These causes of death were not elevated in the refinery group, which showed an overall healthy worker effect. Study problems and future work are discussed.

39572 (INIS-mf–11457(v.1,2) v. 1) **Lung cancer mortality and radiation exposure among the Newfoundland fluorspar miners.** Morrison, H.I. (Department of National Health and Welfare, Ottawa, ON (Canada). Radiation Protection Div.); Semenciw, R.M.; Mao, Y.; Villiers, A.J. de; Wigle, D.T.; Corkill, D.A.; Dory, A.B.; Stocker, H. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

In the early 1950's an unusually large number of lung cancer cases were diagnosed among the fluorspar miners. As a result, in 1956 and 1957, the Department of National Health and Welfare sent J.P. Windish to test for possible causative agents, which unfortunately did not include radiation. In 1959 and 1960, Windish and the A.D. Little Company documented high levels of radiation from radon and its daughter products in the Director mine. The source of the radon was shown to be the ground water which continually poured into the mine. As a result of the high radon levels found, mechanical ventilation was introduced into all mine levels in 1960, and radon daughter levels fell well below 1 working level (WL).

39573 (INIS-mf–11457(v.1,2) v. 1) **Review of all sources of exposure to natural radiation in UK mines.** Dixon, D.W. (National Radiological Protection Board, Chilton (UK)); James, A.C.; Strong, J.C.; Wrixon, A.D. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The results of measurements of short-lived airborne activity, gamma radiation dose rates and activity concentrations of rock samples in eight UK non-coal mines are presented. The data are used to estimate annual doses from thoron daughters, gamma radiation and inhalation and ingestion of dust. The highest estimated doses occur in mines in igneous regions and could amount to about 5 mSv from all sources. It is suggested that within the 50 mSv annual dose equivalent limit an allowance of 10 mSV would be generous for sources other than radon daughters which could then be controlled in relation to an annual exposure of 4 WLM.

39574 (INIS-mf–11457(v.1,2) v. 2) **Physical and environmental surveillance in uranium exploration galleries.** Bassignani, A. (AGIP Nucleare, Milan (Italy)); Ippolito, D.; Fenzi, A.; Pessina, C.M. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Uranium prospection, carried out in Italy by AGIP and now completed, has had the aim of defining national resources. Research has been carried out along all the Alpine regions, Sardinia, Latium and Basilicata. At the present stage two areas of economic interest have been located, at Novazza in Val Seriana and in Val Vedello (Province of Sondrio). The general strategy adopted in the exploration phase to avoid, whenever possible, undue handling of radioactive materials, has been that of excavating tunnels in sterile zones parallel to the mineralized body, and of carrying out quantitative evaluation by drilling. The practical results obtained to date in Val Vedello have already established the existence of 5000 tonnes of U_3O_8 and additional 2300 tonnes from Novazza. Mining activities employed about 150 workers for about five years are now closed because of the low price of uranium and of the delay in the nuclear Italian program. This work summarizes all significant data concerning health physics activities connected with mining operations. A complete evaluation of the total dose (external + internal) received by the workers is presented as well as the formula adopted as a radioprotection standard. External doses have been evaluated on the basis of individual TLD dosimeters, while evaluation of internal doses are mainly achieved by an environmental surveillance program of radon daughter air concentration inside the mines. The external dose received by the workers is lower than 0.2 m Sv/month and internal exposure is less than 6.4×10^{-3} J.h.m.$^{-3}$ per year (or, using the old units, 2 WLM/year). An environmental control program has been also carried out in a wide area surrounding the galleries in order to evidence eventual radiometric alteration due to mining activities. No significant evidence has been found. The data are presented together with their geological correlation.

39575 (INIS-mf–11457(v.1,2) v. 2) **Applications of passive radon dosemeters in mining areas.** Urban, M. (Karlsruhe Nuclear Research Centre (Germany, F.R.). Health Physics Div.); Schmitz, J. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Two different types of passive radon dosemeters developed at Karlsruhe Nuclear Research Center have been tested for their applicability in mines and mining areas. The passive radon diffusion chamber used in the national survey in German houses and outside air has been tested as a working place monitor in mines and as an environmental monitor. The new personal radon dosemeter is applied for miners. For application in mines the data are compared with measurements using the MDA-IWLM 811 and the CEA dosemeter and are correlated to activities in uranium test mines. The radon concentration in the environment of several mines has been determined for several months and correlated to mining activities and meteorological parameters.

39576 (INIS-mf–11457(v.1,2) v. 2) **Dosimetric assessment of risk from exposure to radioactivity in mine air.** James, A.C. (National Radiological Protection Board, Chilton (UK)). Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The aims of this paper are to outline the factual basis of models for dosimetry of the respiratory tract; and to review their application to assess the likelihood of cancer directly from dose absorbed by tissues at risk, according to the procedures recommended by the International Commission on Radiological Protection (ICRP). Dosimetric analysis is thus advantageous in providing an independent evaluation of risk, that can be compared with the wide range of estimates from epidemiological surveys. This comparative approach was adopted by the ICRP to recommend a limit on intake of radon daughter potential alpha-energy in mine air.

39577 (INIS-mf–11457(v.1,2) v. 2) **Non steady-state radiation mine models - fractional applications to personal dosimetry and environmental monitoring.** Bigu, J. (Department of Energy, Mines and Resources, Elliot Lake, ON (Canada). Elliot Lake Lab.). Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

A mine model has been developed that includes a time-dependent radon (thoron) source term, i.e., perturbation term, and ventilation rate. The time-dependent solutions for the concentrations of radon, thoron and their decay products are obtained using the above model for several ventilation rates and an exponential, linear, or sinusoidoil perturbation. Explicit expressions and numerical values derived from the mine model investigated above have been substituted into the basic equations for radiation growth on a sampling filter for environmental monitors and personal dosimeters. Data on the mine model and the activity growth in a sampling filter are presented and discussed.

39578 (INIS-mf–11457(v.1,2) v. 2) **Beta radiation protection considerations in the mining and milling of high grade uranium ore.** Mernagh, J.R. (Toronto Univ., ON (Canada). Dept. of Medicine); Chambers, D.B. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Sevcova et al (1978) reported an observed increased frequency of basal cell carcinoma of the skin in uranium miners and hypothesized that this may be due to external alpha irradiation from radon daughters. For comparative purposes the present paper examines the potential contribution of beta radiation dose to workers arising from contamination of the skin surface by dust in uranium mines and mills.

39579 (INIS-mf–11457(v.1,2) v. 2) **Review of the dosimetry from inhalation of long lived alpha activity in ore dust.** Johnson, J.R. (Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs.). Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The International Atomic Energy Agency (IAEA) has recently recommended values for the annual limits of intake of uranium and thorium ore dust. Their values are based on data recommended by the International Committee on Radiological Protection (ICRP). This paper reviews these calculations of the Annual Limits of Intake (ALI) and concludes that they have a range of at least an order of magnitude in their values. One of the main causes of the large range is the aerosol particle size, and particle size dependent ALI are recommended for use in radiation protection. These values are most likely overly conservative, and their use in calculating risks from exposures to ore dust is not recommended.

39580 (INIS-mf–11457(v.1,2) v. 2) **Pb-210 concentrations in the blood of ground workers and underground miners of zinc-lead mine.** Domanski, T. (Inst. of Occupational Medicine, Lodz (Poland)); Doniec, J.; Chruscielewski, W. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The investigations of Pb-210 concentration in the blood of 140 underground miners and of 80 ground workers, non-miners, are described in the paper. It is found that: (1) the mean concentration of Pb-210 in the blood of non-miners in the industrial region in Poland being approximately 0,11 $Bq.dm^{-3}$ (3,0 pCi/liter) seems to be constant across the age groups and matches the values found in the United States and Sweden; and (2) the use of Pb-210 as a bio-indicator of miner exposure is probably valid even if the break between the end of exposure and blood sampling is avoided.

39581 (INIS-mf–11457(v.1,2) v. 2) **Development of a joint labour-management safety inspection system at Denison operation.** Rickaby, A.C. (Denison Mines Ltd., Elliot Lake, ON (Canada)); Gerard, L.W. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

MINERS/occupational safety; MANAGEMENT; MINERS

39582 (INIS-mf–11457(v.1,2) v. 2) **Establishment of a national calibration centre for practical standards for bioassay and 'in vivo' monitoring.** Limson Zamora, M. (Department of National Health and Welfare, Ottawa, ON (Canada). Radiation Protection Div.); Pomroy, C. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The Radiation Protection Bureau bas been involved in bioassay and 'in vivo' monitoring measurements for many years. During this time, an intercomparison for uranium urinalysis was established, and a range of phantoms acquired for 'in vivo' measurements. In 1983, the Atomic Energy Control Board designated the Bureau to act as Canada's national calibration centre for these measurements. Thus, the Bureau's programs are being placed on a formal basis, and expanded to provide comprehensive coverage of all bioassay and 'in vivo' measurements. This paper will describe the quality assurance programs and services presently available, plans for expansion, and protocols for intercomparisons. Trends identified from data obtained in a study initiated by the Bureau relating performance to analytical methodology will also be discussed.

39583 (INIS-mf–11457(v.1,2) v. 2) **Flexible computer model for radon daughter health risk assessment.** Ginevan, M.E. (Nuclear Regulatory Commission, Washington, DC (USA)). Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

This paper presents a computer model for general analysis of radon risks which allows the user to specify a large number of possible models with a small number of simple commands. The model is written in a version of BASIC which conforms closely to the American National Standards Institute (ANSI) definition for minimal BASIC and thus is readily modified for use on a wide variety of computers, and in particular, microcomputers. The presentation illustrates the use of this model through a number of examples which include examinations of the effects of model selection, smoking status of the population at risk, and exposure regime on radon daughter health risk assessments.

39584 (INIS-mf–11457(v.1,2) v. 2) **Evaluation of radiological hazards associated with mineral sandmining.** Mason, G.C. (Australian Radiation Protection Society, Sydney (Australia)); Cooper, M.B.; Solomon, S.B.; Wilks, M.J. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Radiological hazards that may be involved in the mining of mineral sands are assessed in the light of measurements made at mineral sandmining sites in Australia. The radiation hazard is associated with monazite, which is a small proportion of the total mineral content of the sands. The primary exposure mechanisms are external gamma radiation and inhalation of monazite dust containing thorium and its daughter nuclides. Thoron and thoron-daughter concentrations are found to be very small. In some areas there are uranium-series radionuclides in the mineral sand which give rise to additional exposure. The most difficult hazard to assess accurately is that of inhalation of monazite dust. Particle-size distributions and, particularly, activity concentrations are found to vary during the mineral separation process, depending upon time, place, operations in progress and, to some extent, the method of sampling inhalable air.

39585 (INIS-mf–11457(v.1,2) v. 2) **Radon dilemma.** Steinhausler, F. (Salzburg Univ. (Austria). Inst. fuer Allgemeine Biologie, Biochemie und Biophysik). Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order

Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Radon and its decay products (Rn-d) have been part of man's natural environment through every stage of his evolution; they are inhaled by every breathing species and represent the component of the natural radiation dose to the general public. Lately this issue has become very controversial because of its potential impact on society on a wide range of topics, such as energy conservation and occupational safety of miners.

39586 (INIS-mf–11457(v.1,2) v. 2) **Concentrations of ^{210}Pb in uranium miners' lungs and its states of equilibria with ^{238}U, ^{234}U, and ^{230}Th.** Singh, N.P. (Utah Univ., Salt Lake City (USA). Radiobiology Div.); Bennett, D.; Wrenn, M.E.; Saccomanno, G. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Here we report measurements of the concentrations of ^{210}Pb and ^{210}Po in eight of the miners' lungs in which the concentrations of ^{238}U, ^{234}U and ^{230}Th had already been measured. With these additional data, we determined the absolute and relative amounts of ^{210}Pb and ^{210}Po to ^{238}U, ^{234}U and ^{230}Th, and calculated the additional radiation dose rate from ^{210}Po, an alpha emitter with an energy of 5.305 MeV. We also calculated the radiation dose rates to those uranium miners' lungs from ^{238}U and its daughter products including ^{234}U, ^{230}Th, ^{226}Ra, ^{222}Rn, ^{218}Po, ^{214}Bi and ^{214}Po assuming they are in equilibrium with ^{238}U.

39587 (INIS-mf–11457(v.1,2) v. 2) **Uranium bearing particles in miners' and millers' lungs.** Paschoa, A.S. (Pontificia Univ. Catolica do Rio de Janeiro, RJ (Brazil). Dept. de Fisica); Wrenn, M.R.; Singh, N.P.; Miller, S.C.; Bruenger, F.W.; Jones, K.W.; Cholewa, M.; Hanson, A.L.; Saccomanno, G. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Investigation of the size of residual uranium bearing particles in uranium miners' and millers' lungs is warranted because significant inhalation of uranium dust particles can occur in certain occupational areas. The local uranium concentrations in the particle deposition sites in the lungs are orders of magnitude higher than the average 0.3 ppm ^{238}U throughout the lungs reported in the literature, making microPIXE (particle induced x-ray emission) techniques feasible for detecting such particles. A proton microprobe was used in association with neutron induced autoradiographs to scan lung tissues obtained at autopsy for uranium bearing particles.

39588 (INIS-mf–11457(v.1,2) v. 2) **Alpha dose from long lived emitters in underground uranium mines.** Harley, N.H. (New York Univ., NY (USA). School of Medicine); Fisenne, I.M. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

It is common knowledge that most underground uranium mines in the 1950's were very dusty. Although the major contribution to the bronchial dose was and is due to inhalation of the short lived daughters of radon, inhalation of long lived particulates results in an absorbed alpha dose which can approach 1/2 rad per year. Measurements from two mines are presented to show the airborne activities from the uranium, actinium and thorium series.

39589 (INIS-mf–11457(v.1,2) v. 2) **1983: one year of individual dosimetry in French mines.** Bernhard, S. (Centre d'Etude sur l'Evaluation de la Protection dans le Domaine Nucleaire, 92 - Fontenay-aux-Roses (France)); Pineau, J.F.; Rannou, A.; Zettwoog, P. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The integrated system of individual dosimetry (ISID) developed for uranium mines by the CEA was presented in October 1981. This dosimetry system was legalized in France in late 1982. On 1 January 1983, after ten years of experiments with ISID, the ambient dosimetry based on the measurement of Rn222 was abandoned. For reasons of computer processing, the new system was installed in a single step in all French uranium mines. One thousand seven hundred miners are therefore, equipped with this dosimeter, which supplies monthly potential individual exposures to Po218, Po214, Po212 and Rn222 from which exposures to the potential alpha energy of Rn222 and Rn220 daughters are determined. The dosimeter also gives exposure to long-lived alpha emitters. Very soon, however, in the second month, many problems occurred in implementation. Artefacts appeared, which had not been identified during the experimental qualification campaigns, which concerned a maximum of 200 dosimeters. The artefacts, described below, are associated with the utilization of the equipment. In 1978/1979, one person was busy full-time on 200 dosimeters. In 1982, three persons processed nearly 2000 dosimeters per month. In addition, automative processing systems could not be installed from the outset, and this did not ease matters. Changes in the manufacturing process also raised a number of development problems. These artefacts were analyzed, and then corrected accordingly, and by 1 January 1984, only a few doubtful points remained, for which supplementary experiments are under way. Despite these problems, less than 1 percent of the 18,700 results expected were lost, and the values that were erroneous due to the artefacts were saved in most cases thanks to cross-checks allowed by the high information density offered by this dosimeter. (Abstract Truncated)

39590 (INIS-mf–11457(v.1,2) v. 2) **Gamma doses and radon daughter exposures in some Canadian uranium mines and implications with respect to the proposed regulatory amendments.** Ching, S.H. (Atomic Energy Control Board, Ottawa, ON (Canada)); Ho, K.P.; Bayne, H. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The gamma doses and radon daughter exposures of some Canadian uranium mines workers in 1982 and 1983 are analyzed by statistical techniques. The review includes underground conventional low grade uranium mines in Ontario, and open-pit low grade and high grade uranium mines in Saskatchewan. The distribution of annual gamma doses and radon daughter exposures as percentages of the Maximum Permissible Dose and Exposure in the present Atomic Energy Control Regulations are presented in histograms. The radon daughter exposures are then converted into weighted dose equivalents, combined with the dose equivalents from gamma radiation and some estimated committed dose equivalents due to exposures to long-lived radioactive dust and thoron daughters to form the effective dose equivalents in a manner stipulated in the proposed Amended Regulations. The results are reviewed in terms of the present AEC Regulations and the proposed amended Regulations. It is indicated by this review that the proposed amended Regulations in general would provide more stringent control of radiation exposures.

39591 (INIS-mf–11457(v.1,2) v. 2) **Comparison of methods for monitoring the exposure of miners to radon decay products.** Dixon, D.W. (National Radiological Protection Board, Chilton (UK)); Miles, J.C.H.; Wrixon, A.D. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).*

Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The exposures of 17 miners to radon daughters were estimated for a trial period of one month with active and passive personal dosemeters. The results were compared with estimates from area monitoring by active measurements of radon daughters and passive measurements of radon gas. An average equilibrium factor of 0.47 was derived from spot measurements and a value of 0.58 averaged over the duration of the trial was derived from personal dosemeter measurements. For a representative value of 0.5 the mean estimate from the passive dosemeter differed by 2 percent from the active dosemeter estimate and 2/3 of passive dosemeter results were within 30 percent of the active dosemeter results. The estimates from area monitoring are about 40 percent higher pointing to the value of personal dosimetry.

39592 (INIS-mf–11457(v.1,2) v. 2) **Potential co-carcinogens in the uranium mine environment.** Chambers, D.B. (Senes Consultants, Willowdale, ON (Canada)); Marchant, R.E. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

Studies of increased incidence of lung cancer in uranium miners have focussed on the relationship between lung cancer and miners' exposure to radon daughters and smoking. However, epidemiologic analyses of uranium miner populations also include the effects of exposure to external gamma rays, long-lived alpha emitters and other non-radioactive workplace contaminants. The diversity and variability of miner exposures to potentially carcinogenic substances and combinations of substances, and the natural difficulties involved in the study of lung cancer in human populations, make the assessment of the relative effects of causative agents difficult if not impossible. Moreover, concentrations of most of the substances have rarely been measured in mine environments, and data on human response to these substances is sparse. Nonetheless, research on the potential effects of such substances is required to understand the potential hazards in the mining environment. This paper examines the potential carcinogenic and co-carcinogenic effects of agents other than ionizing radiation, which may currently be present in uranium mine atmospheres.

39593 (INIS-mf–11457(v.1,2) v. 2) **Studies of uranium miners in New Mexico.** Samet, J.M. (New Mexico Univ., Albuquerque (USA)); Morgan, M.V.; Key, C.R.; Valdivia, A.F. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

In 1977 the University of New Mexico initiated a series of investigations to examine morbidity and mortality among uranium miners in the Grants mineral belt, the principal uranium mining area. The major emphasis has been on determining the feasibility of a long-term cohort study of mortality. This report summarizes the current status of the cohort study. Exposure profiles for the Grants area have now been developed from Working Level records for the period 1957 to 1967 and from Working Level Months records for later years. Preliminary findings on mortality and lung cancer are presented.

39594 (INIS-mf–11457(v.1,2) v. 2) **Impact of occupational hazards on the life expectancy of uranium miners.** Myers, D.K. (Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs.); Johnson, J.R. Canadian Nuclear Association, Toronto, ON (Canada). 1985. (CONF-841016–: International conference on occupational radiation safety in mining, Toronto, Ontario, Canada, 15-18 Oct 1984). In *Occupational radiation safety in mining. Proceedings of the international conference (in two volumes).* Order Number DE89619926/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

The health hazards associated with energy production and technological development appear, in terms of their effects on average life expectancy, to be much smaller than the derived health benefits. This is true not only for the general population but also for workers in all portions of the nuclear power industry. However, uranium miners do represent a critical subgroup in which occupational hazards are sufficiently high to affect their average life expectancy appreciably. Uranium mining, like other forms of mining in North America, cannot be considered a 'safe' occupation. Depending upon the exposures to various sources of radiation and the rate of fatal accidents in a given uranium mine, the potential loss of life expectancy due to occupational hazards is calculated to be in the range of one to two years after 40 to 50 years at work. Potential genetic risks due to radiation exposures in uranium mines are expected to be very small.

39595 (INIS-mf–11458) **Survey of diagnostic radiology in the Republic of Ireland.** Cunningham, J.D.; Howett, D.; Hone, C.; Mulholland, C. Nuclear Energy Board, Dublin (Ireland). Mar 1988. 58p. Order Number DE89631327/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

This survey examined a number of aspects of the practice of diagnostic radiology in Ireland. These included the frequency of examinations, the gonadal and active bone marrow doses to patients, the genetically significant dose, the standard of design of x-ray rooms and of performance of equipment, and an inventory of equipment currently in use

39596 (ORNL/TM–11137) **Optimization of the readout procedures for the Harshaw 8800 TL [thermoluminescent] dosimetry system.** Liu, Chwei-jeng (James); Sims, C.S.; Rhea, T.A. Oak Ridge National Lab., TN (USA). Jul 1989. 28p. Sponsored by DOE Environment Health & Safety. DOE Contract AC05-84OR21400. Order Number DE89014327/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The optimization of the readout procedures for Harshaw's LiF-TLDs and it 8800 automatic TLD reader were studied. The optimization was based on the TLD sensitivity stability during 8-10 recycling uses. Three types of TLDs under several exposure conditions (gamma and neutron, low and high doses, and different fading times), five different types of TL light signals, and three different heating time-temperature-profiles (TTPs) were involved in the stability performance studies. The results show that the optimum readout procedures for all exposure cases can be achieved by using the Harshaw-suggested TTP heating methods and the TL light signals of some certain carefully-chosen regions of interest and peaks 3+4+5. The practical experience gained from using the computerized glow curve deconvolution (CGCD) program in the reader is also discussed. 17 refs., 5 figs., 6 tabs.

39597 (PNL-SA–17035-HEDR) **Defining demographic categories for Phase 1.** Napier, B.A.; Beck, D.M. Pacific Northwest Lab., Richland, WA (USA). May 1989. 7p. Sponsored by DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-8905180–1: Technical steering panel meeting, Toppenish, WA, USA, 19-20 May 1989). Order Number DE89014283/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Definition of a number of parameters is required before radiation dose calculations can be performed. These include the location and size of the areas of interest, groupings of the people living in these areas (divided by age and by other relevant factors), and the classification of the types of food these people may have eaten. Once these types of information are arranged in a data base, doses can be systematically calculated. Operational definitions of many of the most important parameters are given in this presentation. This status information is provided for TSP consideration.

39598 (Stralenbescherming–34) **Estimated radiation burden in the Netherlands in 1986. First intermediate report.** Blaauboer, R.O.; Vaas, L.H.; RIVM-Min. VROM Collaboration. Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Directie Stralenbescherming. Jul 1988. 136p. (In Dutch). (VROM–80406/11-88-5337/84). Order Number DE89631329/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Includes list of acronyms.

In the framework of the project that reports about radiation hygiene, the radiation protection situation in the Netherlands is

examined. An overall picture is given of the exposure of the population to the various sources of ionizing radiation in the year 1986. As this project is still in progress, only a limited number of the existing sources has been examined thoroughly. These sources are cosmic radiation, terrestrial radiation (excluding radon and thoron), enhanced natural radiation from building materials and air traffic, and medical applications in diagnostic x-rays and radiotherapy. Using methodical procedures detailed information on these sources has been given on source terms, critical pathways and groups of exposed persons, radiation doses, dose distributions and time dependent tendencies. In addition a comparison is made with the mean dose in other countries. The remaining radiation sources are briefly discussed. (author). 81 refs.; 36 figs.; 37 tabs.

39599 (Stralenbescherming–39-C) **Accountability system ALARA/optimization.** Hof, G.J.J. van den; DHV Raadgevend Ingenieursbureau-Ministerie VROM Collaboration. Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Directie Stralenbescherming. Dec 1988. 42p. (In Dutch). Order Number DE89631295/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Is also affected to TRN NL89C0443, NL89C0446-NL89CO450.

This report makes part of a series of eight reports which have been drawn up in behalf of the dutch Policy Notition Radiation Standards (BNS). The aim of the project with which this report deals, is to assess an accountability system for application of ALARA (As Low As Reasonable Achievable)/optimisation and from these forthcoming bottlenecks. Herein (for this subproject) ALARA is defined as optimization of radiation protection below a risk limit which is to be assessed in another framework. In ch. 2 this discussed further. First it is indicated which categories applications/activities are to be distinguished. Then the elements of the accountability system are elaborated further. In ch. 3 a discussion is given of the actual legislation, the actual policy (national and international), the practice developed with regard to ALARA/optimization and the boundary condition forthcoming from these. In ch. 4 finally the results of ch. 2 are enlightened upon governmental consequences against the background of the actual situation, outlined in ch. 3. In behalf of the insight in the actual practice of ALARA/optimization and the governmental consequences of the in ch. 2 elaborated system interviews have been made with radiation-protection specialists. These are summarized in appendix 2. (H.W.).

39600 (Stralenbescherming–39-D) **Environment-quality demands.** Delfini, M.G.; Leenhouts, H.P.; RIVM-Ministerie VROM Collaboration. Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Directie Stralenbescherming. Dec 1988. 42p. (In Dutch). Order Number DE89631296/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Is also affected to TRN NL89C0443-NL89CO444, NL89C0447-NL89CO450.

In the framework of the Environment Quality Requirements (MKE) project a model has been designed in which environment-quality demands have been defined and quantified, and a measuring strategy has been developed. In the model it is required for the quality of the environment that the radionuclide concentration in the various environment compartiments remains limited in order to keep the effective dose equivalence for the 'reference man' under a certain reference level. In order to be able to determine the maximum nuclide concentration it is necessary to quantify the relation between the concentration in the environment and the dose for the people. The quantitative relation between concentration and dose has been established on the base of parameters (Derived Activity Limits (DAL's)) which have to be calculated for each environment compartiment, each nuclide and each exposure pathway. This model has been described and, as example, the DAL's have been calculated for the compartiment air (for which the two exposure pathways inhalation and direct radiation were considered). For the other environment compartiments a similar elaboration is needed. The feasibility of application of the MKE-model in the actual practice of measurements in the environment and examination of dose for the population depends upon the possibility for performing nuclide specific measurements in all environment compartiments, the level of the dose resulting from the contamination of the environment and the related accurateness of the measurements.

39601 (Stralenbescherming–39-E) **Emission- and product standards.** Jong, P. de; MT TNO-Ministerie VROM Collaboration. Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). Directie Stralenbescherming. 28 Dec 1988. 66p. (In Dutch). Order Number DE89631297/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

Is also affected to TRN NL89C0443-NL89CO445, NL89C0448-NL89CO450.

This report makes part of a series of eight reports which have been drawn up in behalf of the dutch Policy Notition Radiation Standards (BNS). In this report the results are presented of an inventarization of the use of radioactive materials and ionizing-radiation emitting apparates in the Netherlands. Ch. 2 deals with the varous applications of radioactive materials in the Netherlands. Herein also the numbers and the various locations by application, and the amounts and character of the radioactive materials used, come under discussion. Besides, the various waste currents are considered separately. The use of ionizing-radiation emitting apparates is treated in ch. 3. In ch. 4 the differences and agreements of the various applications, concentrating on the emission and product standards to be drawn up, are entered further. Also on the base of these considerations, a number of starting points are formulated with regard to the way in which emission and product standards may be drawn up. Ch. 7 deals with the conclusions and indicates the most important hiates. (H.W.). 25 refs.; 5 figs.; 25 tabs.

39602 Dose enhancement in buildup region by lead, aluminum, and lucite absorbers for 15 MVp photon beam. Ciesielski, B. (Medical Academy, Institute of Medical Biology, Department of Physics and Biophysics, Debinki 1, 80-211 Gdansk, Poland(PL)); Reinstein, L. E.; Wielopolski, L.; Meek, A. *Medical Physics (USA)*, 16(4): 609-613 (Jul 1989).

Changes in dose distributions in buildup region resulting from the presence of lead, aluminum, and lucite absorbers above the surface of a polystyrene phantom were evaluated. The surface dose, as a function of the absorber thickness, is presented as well as the influence of the air gap between the lead absorber and the phantom surface. It has been found that the surface dose does not depend on absorber thickness for absorbers thicker than the range of secondary electrons in the absorber material (after corrections for the attenuation of the primary beam in the absorber). Similarly, the depth dose curves in the phantom were elevated only at depths lower than the range of secondary electrons in the phantom. The applicability of the presented data in clinical radiotherapy is discussed.

6560 Condensed Matter Physics

Refer also to citation(s) 38769, 38811, 38960, 38962, 39626

39603 (CBPF-NF–062/88) **Molecular orbital calculations of the unpaired electron distribution and electric field gradients in divalent paramagnetic Ir complexes.** Nogueira, S.R.; Vugman, N.V.; Guenzburger, D. Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ (Brazil). 1988. 35p. Order Number DE89630236/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Semi-empirical Molecular Orbital calculations were performed for the paramagnetic complex ions $[Ir(CN)_5]^{3-}$, $[Ir(CN)_5Cl]^{4-}$ and $[Ir(CN)_4Cl_2]^{4-}$. Energy levels schemes and Mulliken-type populations were obtained. The distribution of the unpaired spin over the atoms in the complexes was derived, and compared to data obtained from Electron Paramagnetic Resonance spectra with the aid of a Ligand Field model. The electric field gradients at the Ir nucleus were calculated and compared to experiment. The results are discussed in terms of the chemical bonds formed by Ir and the ligands.

39604 (CONF-8906161–4) **Methods of channeling simulation.** Barrett, J.H. Oak Ridge National Lab., TN (USA). Jun 1989. 21p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From Ion beam analysis conference; Kingston, Canada; 26-30 Jun 1989. Order Number DE89015062/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Many computer simulation programs have been used to interpret experiments almost since the first channeling measurements were made. Certain aspects of these programs are important in how accurately they simulate ions in crystals; among these are the manner in which the structure of the crystal is incorporated, how any quantity of interest is computed, what ion-atom potential is used, how deflections are computed from the potential, incorporation of thermal vibrations of the lattice atoms, correlations of thermal vibrations, and form of stopping power. Other aspects of the programs are included to improve the speed; among these are table lookup, importance sampling, and the multiparameter method. It is desirable for programs to facilitate incorporation of special features of interest in special situations; examples are relaxations and enhanced vibrations of surface atoms, easy substitution of an alternate potential for comparison, change of row directions from layer to layer in strained-layer lattices, and different vibration amplitudes for substitutional solute or impurity atoms. Ways of implementing all of these aspects and features and the consequences of them will be discussed. 30 refs., 3 figs.

39605 (JINR-D–17-88-95, pp. 146-153) **Paramagnetic properties of electrons in the Hubbard model and Bose condensation.** Zajtsev, R.O. (AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii); Ivanov, V.A. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. (In Russian). (CONF-8708341–: 4. International symposium on selected topics in statistical mechanics, Dubna, USSR, 25-29 Aug 1987). In *4. International symposium on selected topics in statistical mechanics.* Order Number DE89012150/JAW. Available from NTIS (US Sales Only), PC A21/MF A01; INIS.

Paramagnetic properties of electrons in the Habbard model and electron pair Bose-condensation are investigated. It is shown that purely kinematic interaction of electron excitations can lead to rather to a superconducting state: T_c of the order of electron energy band width. Dynamic Coulomb interaction changes the temperature of T_c transition to superconducting state so that concentration dependence $T_c(x)$ agrees qualitatively with certain experiments on high-temperature superconductivity. 9 refs.; 6 figs.

39606 (JINR-D–17-88-95, pp. 162-164) **Quasi-one-dimensional Krumhansl-Schrieffer model and diffuse scattering in structurally-instable crystals.** Izyumov, Yu.A. (AN SSSR, Sverdlovsk (USSR). Inst. Fiziki Metallov); Laptev, V.M. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. (In Russian). (CONF-8708341–: 4. International symposium on selected topics in statistical mechanics, Dubna, USSR, 25-29 Aug 1987). In *4. International symposium on selected topics in statistical mechanics.* Order Number DE89012150/JAW. Available from NTIS (US Sales Only), PC A21/MF A01; INIS.

Quasi-one-dimensional Krumhansl-Schrieffer model for investigation into charged particle diffusive scattering in structurally instable crystals going through phase transitions is used. When analysing scattering in the non-linear system the consideration is not reduced to kink contribution because the contribution of localized phonons linked with kinks and the interference effect for kinks and normal propagating phonons coincide with it by the value. 3 refs.; 1 fig.

39607 (JINR-D–17-88-95, pp. 444-467) **Moessbauer effect in magnetic materials.** Yukalov, V.I. (Joint Inst. for Nuclear Research, Dubna (USSR)). Joint Inst. for Nuclear Research, Dubna (USSR). 1988. (In Russian). (CONF-8708341–: 4. International symposium on selected topics in statistical mechanics, Dubna, USSR, 25-29 Aug 1987). In *4. International symposium on selected topics in statistical mechanics.* Order Number DE89012150/JAW. Available from NTIS (US Sales Only), PC A21/MF A01; INIS.

Review of experimental and theoretical works on Moessbauer effect observation in material going through a phase transition from paramagnetic to magnetic state (including ferromagnetic, antiferromagnetic of ferrimagnetic state) is given. A generally accepted interpretation of anomalous increase of area under the resonance spectrum at the temperatures lower than the crytical one, as a phenomenon caused by magnetostriction is discussed. Based on theoretical calculations and experimental data analysis it is shown that this interpretation is not right. Another explanation of this anomaly based on internal conversion coefficient reduction due to gamma-radiation increase under effective magnetic field occurence is proposed. An explanation of gap in Moessbauer probability in the critical point as a phenomenon caused by the presence of heterophase fluctuations in the critical area is given. 60 refs.; 1 fig.; 1 tab.

39608 (JINR-E–3-88-459) **Neutron depolarization study of static magnetization fluctuation in ferromagnets.** Dokukin, E.B.; Korneev, D.A.; Loebner, W.; Pasyuk, V.V.; Petrenko, A.V.; Rzany, H. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics. 1988. 6p. Order Number DE89630242/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to International Conference on Magnetism ICM'88, Paris, France, July 25-29, 1988.

Neutron depolarization studies using pulsed polarized neutrons have been performed to get information on mean magnetization, static magnetization fluctuations and magnetic anisotropy in plate-like ferromagnetic samples. The approach to magnetic saturation of polycrystalline ferromagnets ($(Fe_{50}Ni_{50})_{96}Cr_4$, MnZn-ferrit, and $Fe_{98}D_{42}$) was studied by analysing the field dependence of depolarization parameters. 9 refs.; 4 figs.; 1 tab.

39609 (JINR-E–14-88-568) **Analysis of high temperature superconductors by means of PIXE and RBS methods.** Il'khamov, R.A.; Kobzev, A.P.; Sandrik, R.; Valentovic, D. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics. 1988. 8p. Order Number DE89630241/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to the 7-th Conference on Analytical Spectroscopy, September, 1988, Torun, Poland.

The non-destructive ion beam element analyses of the high temperature superconductors are presented. The bulk analysis of materials of Y-Ba-Cu-O composition by the PIXE method and study of thin films of these materials by RBS method are proposed. The concentrations of the elements have been calculated by means of external standards technique in the case of PIXE method and by means of experimental spectrum modeling in the case of RBS. The elemental composition can be measured with accuracy not less than 4,5, 4,0 and 4,5% for Cu,Y and Ba respectively. 8 refs.; 6 figs.; 2 tabs.

39610 (KEK–88-7, pp. 74-91) **Fundamental study of negative ion beam application to ion implantation and ion beam deposition.** Tsuji, Hiroshi (Kyoto Univ. (Japan). Dept. of Electronics); Ishikawa, Junzo. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Oct 1988. (CONF-8804288–: Symposium on negative ion sources and their applications, Tsukuba, Japan, 5-6 Apr 1988). In *Proceedings of the symposium on negative ion sources and their applications.* Order Number DE89012159/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

We constructed a prototype negative ion implanter and a negative ion beam deposition system with a sputter-type heavy negative ion source. The fundamental problems, associated with the application of negative ion beam in material modification by ion implantation and in film formation by ion beam deposition, were investigated. The advantages and possibilities of negative ion beam application were described based on the results of apparatus construction and experiments of negative ion implantation and negative ion beam deposition.

39611 (KEK–88-7, pp. 92-97) **Negative ion source and MeV ion implanter.** Iwamoto, E. (Nissin - High Voltage Co. Ltd., Kyoto (Japan)); Fukushima, E.; Sakamoto, O. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Oct 1988. (CONF-8804288–: Symposium on negative ion sources and their applications, Tsukuba, Japan, 5-6 Apr 1988). In *Proceedings of the symposium on negative ion sources and their applications.* Order Number DE89012159/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

The report describes a commercial cesium sputter negative ion source, Model NIS-137, for heavy ions and a high energy ion implanter, Model NI-1000, developed by Nissin-High Voltage Co., Ltd. The negative heavy ion source is a reverse type cesium sputter ion source. A 90 deg. magnet analyzes the ion beam coming from the ion source and measures their spectra. Entrance and exit slits are provided to control the beam size and position. A Faraday Cup is used to catch the analyzed beam. Extraction voltage is supplied to the sputter target from the earth potential so that the beam energy

is kept constant, independent of the cathode voltage which is supplied between the ion source body and the sputter target. Once an optimum condition is achieved, the ion source can operate continuously for more than 30 hours with high stability. The Model NT-1000 implanter is designed for the semiconductor industry. The above-mentioned cesium sputter negative ion source is used to produce ion beams. Permanent magnets are attached in each electrode of the acceleration tubes to restrict the acceleration of secondary electrons and the increase in the number of electrons by avalanche. As a result of this electron restriction, X-ray radiation is reduced drastically. Computer simulation is carried out to study the effect of the permanent magnets on the trajectories of secondary electrons. (N.K.).

39612 (LA-UR–89-2100) **Thomas-Fermi equation of state: The hot curve.** Baker, G.A. Jr.; Johnson, J.D. Los Alamos National Lab., NM (USA). 1989. 12p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890894–1: 13. international workshop on condensed matter theories, Campos de Jordao (Brazil), 6-12 Aug 1989). Order Number DE89014229/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We derive the high-temperature limit of the equation of state based on the Thomas-Fermi statistical theory of the atom. The resulting "hot curve" is in fact the ideal Fermi gas. We expand the thermodynamic properties of this gas in powers of the fugacity and use this expansion to construct a representation of the pressure, accurate to about 0.1%. This representation is compared with the actual theory for aluminum and the "hot curve" is found to represent it well over a large region of interest in applications. 10 refs., 3 figs., 1 tab.

39613 (PNL-SA–16890) **Energy and angular distributions of electrons emitted from gases and thin foils during light ion bombardment.** Toburen, L.H. Pacific Northwest Lab., Richland, WA (USA). May 1989. 67p. Sponsored by DOE Energy Research. DOE Contract AC06-76RL01830. (CONF-8905179–1: 8. Pfefferkorn conference on fundamental beam interactions with solids for microscopy, microanalysis and microlithography, Park City, UT, USA, 7-12 May 1989). Order Number DE89014445/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The energy and angular distributions of electrons ejected by fast charged particles in ionizing collisions provide detailed information regarding the effects of atomic, molecular, and condensed-phase structure on the energy loss process. In this paper, the cross sections for electron production by light ions will be reviewed with emphasis on the effects of projectile and target structure on the magnitude and spectral properties of the energy and angular distributions of ejected electrons. Analysis of the wide range of available data has lead to several general conclusions. For ionization of atomic and molecular targets by protons having energies above a few hundred keV, the cross sections for electron production have been found to scale as the number of loosely bound target electrons. 48 refs., 26 figs.

39614 Physics of condensed matter at extreme conditions. Ross, M. (Lawrence Livermore National Lab., Univ. of California, Livermore, CA (US)). v.v of High intensity laser-matter interactions. Campbell, E.M.; Baldis, H. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-8801117–: High intensity laser matter interactions, Los Angeles, CA, USA, 12-13 Jan 1988).

The study of matter under extreme conditions is a highly interdisciplinary subject with broad applications to materials science, geophysics and astrophysics. High-pressure properties are studied in the laboratory using static and dynamic techniques. The two differ drastically in the methods of generating and measuring pressure and in the fundamentally different nature of the final compressed state. This article covers a very broad range of conditions, intended to present an overview of important recent developments and to emphasize the behavior of materials and the kinds of properties now being studied.

39615 Computing classically exact diffusion constants using short-time trajectories. Voter, A. F. (Theoretical Division (T-12, MS J569), Los Alamos National Laboratory, Los Alamos, New Mexico 87545(US)). *Physical Review Letters (USA)*, 63(2): 167-170 (10 Jul 1989).

The classical diffusion constant of a point defect in an infinite lattice of binding sites is shown to be expressible as transition-state-theory rates multiplied by dynamical correction factors computed from short-time classical trajectories initiated at the site boundaries. The expression, which results from time differentiating the lattice-discretized mean-square displacement, is valid at any temperature for which the site lattice is well defined. It thus avoids both the time-scale limitations of direct molecular dynamics and the rare-event requirements of standard dynamical-correction methods.

39616 Nonclassical nucleation and growth of cohesive tensile cracks. Rundle, J. B. (Division 6231, Sandia National Laboratories, Albuquerque, New Mexico 87185(US)); Klein, W. *Physical Review Letters (USA)*, 63(2): 171-174 (10 Jul 1989). DOE Contract AC04-76DP00789.

We analyze the nucleation and growth of cohesive tensile cracks using a field-theoretic formulation in which the free energy is written as a functional of the crack separation (offset field). Our results indicate that for certain materials, crack nucleation and growth proceed through the formation and extension of a diffuse "halo" surrounding the classical portion of the crack. This is similar to nonclassical nucleation in magnetic systems. Theoretical considerations and numerical calculations strongly suggest that the diffuse halo can be identified with the fracture "process zone" seen in laboratory studies of advancing cracks.

39617 Spin Hamiltonian for which quantum hall wavefunction is exact. Laughlin, R. B. (Department of Physics, Stanford University, Stanford, California 94305, and Lawrence Livermore National Laboratory, P.O. Box 808, Livermore, California 94550 (US)). *Annals of Physics (New York) (USA)*, 191(1): 163-202 (Apr 1989). DOE Contract W-7405-ENG-48.

A Hamiltonian is introduced for which the spin-1/2 quantum liquid wavefunction proposed by Kalmeyer and Laughlin is the exact ground state. An explicit proof is given that this state is a doubly degenerate spin singlet. The excitation spectrum of the Hamiltonian is calculated variationally and a case is made for the presence of an energy gap. The spin-1 collective mode, calculated in the single-mode approximation, is shown to have a large energy that is minimized at the Brillouin zone corner. The spin-0 collective mode behaves similarly but has lower overall energy. Wavefunctions for the neutral spin-1/2 excitations are shown to form an exact spin doublet. The energy of a pair of such excitations increases or decreases logarithmically with separation depending on the total spin. When widely separated, the excitations possess an internal 2-fold degree of freedom, a Brillouin zone that is half the linear dimension of the full zone, and a mass comparable to that of the collective modes. © Academic Press, Inc. 1989

39618 Phason elasticity in entropic quasicrystals. Strandburg, K. J. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439(US)); Tang, L.; Jaric, M. V. *Physical Review Letters (USA)*, 63(3): 314-317 (17 Jul 1989). DOE Contract W-31-109-ENG-38.

The equilibrium quasicrystal phase of a two-dimensional two-component Lennard-Jones atomic system and two different ensembles of random tilings (binary and uncontrained) are analyzed by means of Monte Carlo simulations. We find that the quasicrystal phase in the atomic system is well described by the random-tiling model. Despite the nonzero configurational entropy density, the phason fluctuations are found not to destroy the quasi-long-range translational order in this phase, in agreement with conjectured square-gradient phason elasticity. Nearly identical, temperature-independent, reduced, phason elastic constants are determined in all three cases.

39619 Monte Carlo study of randomly diluted ferromagnetic thin films. Soukoulis, C. M. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011(US)); Grest, G. S.; Velgakis, M. *Physical Review [Section] B: Condensed Matter (USA)*, 40(1): 467-470 (1 Jul 1989). DOE Contract W-7405-ENG-82.

Using Monte Carlo simulations, we have studied the Ising model with random,nonmagnetic impurities on an $N \times N \times L$ simple cubic lattice. Systems withferromagnetic nearest-neighbor coupling and periodic boundary conditions in the$x$-y plane are studied for N=40 and$1 \leq L \leq 40$ for several values of p, the concentration ofmagnetic ions. The average magnetization, susceptibility, and specific heat arecalculated as a function of temperature for different values of L and$p$. The transition temperature T_c decreases monotically tozero as the concentration p decreases towards the percolation thresholdfor the width L. The shift of T_c is consistent with$L^{-\lambda}$, where λ is equal to 1.56 in the critical region.

39620 Thermodynamics of the single-channel Kondo impurity of spin $S(\leq(7/2)$ in a magnetic field. Sacramento, P. D. (Department of Physics, Temple University, Philadelphia, Pennsylvania 19122(US)); Schlottmann, P. *Physical Review [Section] B: Condensed Matter (USA),* 40(1): 431-436 (1 Jul 1989).

The thermodynamic Bethe-ansatz equations of the *s-d* exchange-model of arbitrary spin S (derived by Fateev and Wiegmann) are solvednumerically. We present the magnetic field and temperature dependence of thespecific heat, the entropy, the magnetization, and the susceptibility for$S \leq 7/2$.

39621 Path-integral simulation of positronium in a hard sphere. Liu, Z. (Materials Science Department, State University of New York, Stony Brook, New York 11794(US)); Broughton, J. *Physical Review [Section] B: Condensed Matter (USA),* 40(1): 571-577 (1 Jul 1989).

We employ the path-integral Monte Carlo method to study the binding energyof positronium trapped within a hard sphere. The two-body density matrix andthe total- and kinetic-energy matrices are obtained by matrix squaring. Thepair-product approximation is then used to obtain the entire density andestimator matrices for the Monte Carlo simulation. Ground-state bindingenergies are obtained as a function of sphere radius and the system is found tobecome unbound near a radius of 4 bohrs. Annihilation times are calculated-which vary from 125 ps for free-space positronium down to 76 ps at a sphereradius of 4 bohrs.

39622 Grazing-angle neutron diffraction. Ankner, J. F. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, 1110 West Green Street, Urbana, Illinois 61801(US)); Zabel, H.; Neumann, D. A.; Majkrzak, C. F. *Physical Review [Section] B: Condensed Matter (USA),* 40(1): 792-795 (1 Jul 1989). DOE Contract AC02-76ER01198.

We report the first grazing-angle neutron-diffraction experiment. Byrelaxing all collimations except that of the incident beam, we have obtainedadequate intensity to observe simultaneously the specularly reflected and$(1\bar{1}1)$ grazing-angle diffracted beams from the (110) surface of alarge perfect silicon crystal. This measurement demonstrates that, underappropriate experimental conditions, grazing-angle neutron diffraction can beused as a probe of surface and interface structures. The technique can be usedto particular advantage with those materials to which neutrons are uniquelysensitive, e.g., magnetic or hydrogen-rich thin films.

39623 Ground-state and low-lying excitations of the Heisenberg antiferromagnet. Carlson, J. (Theoretical Division, MSB283 Los Alamos National Laboratory, Los Alamos, New Mexico 87545(US)). *Physical Review [Section] B: Condensed Matter (USA),* 40(1): 846-849 (1 Jul 1989).

Monte Carlo methods are used to determine the exact ground-state energy ofthe spin-1/2 Heisenberg antiferromagnet on two-dimensional square periodic lattices up to size 32 x 32. The extrapolated ground-state energy for infinite lattice size is -0.33459 ± 0.000 05. In addition, splittings between the ground state and the lowest spin-1 and -2 excitations are determined as a function of lattice size. The scaling of both the ground-state energy and the gap are inagreement with that predicted by spin-wave theory over a wide range of lattice sizes. In particular, numerical results demonstrate convincingly the lack of agap for infinite systems, and that the gap for finite systems scales with the inverse volume of the lattice. Finally, we present results for the ground-state spin-correlation function. Our approximate results for larger lattices indicate that the staggered magnetization is 0.34 ± 0.01 units where the saturated value is (1/2).

6561 Superconductivity

Refer also to citation(s) 38755, 38758, 38782, 38783, 38799, 38802, 38803, 38806, 38808, 38953, 38954, 38958, 38959, 38961, 38963, 39605

39624 (JINR-D–17-88-95, pp. 280-290) **Anharmonic model for high - T_c superconductors.** Plakida, N.M. (Joint Inst. for Nuclear Research, Dubna (USSR)); Aksenov, V.L.; Drechsler, S.L. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. (CONF-8708341–: 4. International symposium on selected topics in statistical mechanics, Dubna, USSR, 25-29 Aug 1987). In *4. International symposium on selected topics in statistical mechanics.* Order Number DE89012150/JAW. Available from NTIS (US Sales Only), PC A21/MF A01; INIS.

The high temperature superconductivity in oxide materials is considered on the basis of the anharmonic model. The pseudo-spin model for the soft mode connected with the tilting of CuO_6 octahedra is introduced. Eliasberg-type equations are obtained for the pseudo-spin model. The parameters envolved into the model and T_c are estimated for $La_{2-x}(Ba,Sr)_xCuO_4$ and YBa_2CuO_4. 34 refs.

39625 Expansion in $1/z$ for the transition temperature of granular superconductors. Fishman, R. S. (Solid State Division, P.O. Box 2008, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6032(US)). *Physical Review Letters (USA),* 63(1): 89-92 (3 Jul 1989). DOE Contract AC05-84OR21400.

An expansion in powers of $1/z$ is used to study the effect of phase fluctuations on the transition temperature of a granular superconductor, modeled as an array of Josephson junctions. The lowest-order correction to T_c/zJ diverges to negative infinity at the grain diameter $\alpha = zJ/U = 2$ and reaches the value $-1/2z$ when $\alpha = \infty$, which corresponds to the classical *XY* model. The lowest-order correction to the critical grain diameter is also calculated.

39626 Competition of pairing and Peierls–charge-density-wave correlations in a two-dimensional electron-phonon model. Scalettar, R. T. (Department of Physics, University of Illinois, Urbana, Illinois 61801(US)); Bickers, N. E.; Scalapino, D. J. *Physical Review [Section] B: Condensed Matter (USA),* 40(1): 197-200 (1 Jul 1989).

Monte Carlo simulations are used to investigate the competition betweensuperconducting and Peierls–charge-density-wave (CDW) correlations in atwo-dimensional electron-phonon system. The dependence of these correlations onthe band filling $\langle n \rangle$, phonon frequency ω_0, andelectron-phonon coupling g is examined. The Peierls-CDW correlations arefavored as $\langle n \rangle$ moves towards half-filling, $\omega_0$decreases, and g increases. When the Peierls-CDW correlations are weak,the Monte Carlo results for the superconducting correlations are found to be inexcellent agreement with the results obtained using the well-known Eliashbergapproximation.

39627 Ginzburg-Landau theory of deformable superconductors. Svensmark, H. (Department of Physics, University of California, Berkeley, California 94720(US)); Falicov, L. M. *Physical Review [Section] B: Condensed Matter (USA),* 40(1): 201-209 (1 Jul 1989). DOE Contract AC03-76SF00098.

A Ginzburg-Landau theory is presented for a superconductor that can alsosustain a weakly first-order structural phase transition. The distortion andthe superconducting order parameters are coupled so that the distorted systemtends to favor superconductivity. The equations are solved for a variety ofsituations. It is found that for some range of the parameters a distorted,superconducting equilibrium bulk could have, when superconductivity is locallydestroyed (e.g., by the presence of a magnetic field), an undistorted surfacelayer, discontinuously superimposed on the bulk; and that for a different rangeof parameters a nonsuperconducting, undistorted equilibrium bulk can sustainsurface superconductivity in the presence of a local, surface distortion. Thediscontinuous changes in the distortion parameter introduce, in effect, anadditional coherence length, not calculable from dimensional arguments. Thetheory could be applicable to the new ceramic high-temperature superconductors,and may perhaps serve as a basis for the description of the appearance anddisappearance, repeatedly observed, of nonequilibrium very-high-temperaturesuperconductivity in some oxides.

6570 Theoretical and Mathematical Physics

Refer also to citation(s) 39461, 39465, 39470, 39530, 39612

39628 (INIS-mf–11480, pp. 10) **Investigations on the Berry phase.** Bulla, W.; Falkensteiner, P.; Grosse, H. Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik. Nov 1988. (In German). In *Annual report of the Institute for Theoretical Physics in Graz, Austria.* Order Number DE89631627/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

QUANTUM MECHANICS/dirac operators; EIGENVALUES; PROGRESS REPORT; U-2 GROUPS

39629 (INIS-mf–11480, pp. 17-18) **Moment method for solving the nonlinear Boltzmann equation.** Schuerrer, F.; Kuegerl, G. Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik. Nov 1988. (In German). In *Annual report of the Institute for Theoretical Physics in Graz, Austria.* Order Number DE89631627/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

BOLTZMANN EQUATION/analytical solution; GASES/hard-sphere model; GASES/relaxation; GASES; RELAXATION; MOMENTS METHOD; NONLINEAR PROBLEMS; PROGRESS REPORT

39630 (INIS-mf–11480, pp. 2) **Rosette trajectories in the special, the four-dimensional general- and the projective relativity theory.** Ledinegg, E. (Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik); Schoenfelder, A. Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik. Nov 1988. (In German). In *Annual report of the Institute for Theoretical Physics in Graz, Austria.* Order Number DE89631627/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

GENERAL RELATIVITY THEORY/trajectories; RELATIVITY THEORY/trajectories; COMPARATIVE EVALUATIONS; TRAJECTORIES; PROGRESS REPORT

39631 (IYaF–88-34) **Resonance effect on the oscillator distribution function.** Gerasimov, A.L. AN SSSR, Novosibirsk (USSR). Inst. Yadernoj Fiziki. 1988. 16p. (In Russian). Order Number DE89630105/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A problem on equilibrium distribution function (EDF) of multi-dimensional non-linear oscillator with external perturbation, periodic in time, in the presence of dissipation and external noise is considered. A situation with resonance of arbitrary (indefinitely low) V_0 harmonic is considered. Fokker-Planck equation is taken as a model one. It is shown that the resonance starts to effect the EDF exponential tails only when its width p_r becomes of the order of noise force. 3 refs.; 2 figs.

39632 (JINR-D–17-88-95, pp. 12-23) **Hamiltonian formulation of the based on first principles theory of multi-photon processes in atoms.** Bakasov, A.A. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. (In Russian). (CONF-8708341–: 4. International symposium on selected topics in statistical mechanics, Dubna, USSR, 25-29 Aug 1987). In *4. International symposium on selected topics in statistical mechanics.* Order Number DE89012150/JAW. Available from NTIS (US Sales Only), PC A21/MF A01; INIS.

Based on the first principles of quantum electrodynamics Hamiltonian which describes two- and multiphoton processes is derived. The problem of sequential derivation and microscopic grounding of multiphoton process models widely used in quantum optics is solved. The first correction to Pauli equation is derived. An explicit form of the coupling constant for two-level atom interacting with two photons is given. A method for calculating the interaction constants for multilevel atoms with multiphoton transitions is indicated. Other results obtained within the framework of the approach developed are presented. 52 refs.; 2 figs.

39633 (JINR-D–17-88-95, pp. 47-54) **On probability functions with topological contraints and path integrals.** Bernido, Ch.C. (University of the Philippines, Quezon City (Philippines)). Joint Inst. for Nuclear Research, Dubna (USSR). 1988. (CONF-8708341–: 4. International symposium on selected topics in statistical mechanics, Dubna, USSR, 25-29 Aug 1987). In *4. International symposium on selected topics in statistical mechanics.* Order Number DE89012150/JAW. Available from NTIS (US Sales Only), PC A21/MF A01; INIS.

To demonstrate that topological constraints can give rise to unexpected results in quantum physics the authors considered the path integral treatment of the Aharonov-Bohm (AB) effect. It is shown that apart from the usual AB magnetic-flux-dependent shifts, there are also topological shifts due to the winding numbers. The standard AB set-up is presented where a solenoid is used. The point constraint in a plane is shown to be the appropriate setting for the path integral evaluation of the AB effect. The topological contributions found in the Aharonov-Bohm set-up are illustrated. 8 refs.; 4 figs.

39634 (JINR-D–17-88-95, pp. 115-118) **On the solution of the inverse scattering problem on a ray.** Egikyan, R.S. (Erevanskij Fizicheskij Inst., Erevan (USSR)); Zhidkov, E.P. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. (In Russian). (CONF-8708341–: 4. International symposium on selected topics in statistical mechanics, Dubna, USSR, 25-29 Aug 1987). In *4. International symposium on selected topics in statistical mechanics.* Order Number DE89012150/JAW. Available from NTIS (US Sales Only), PC A21/MF A01; INIS.

Quantum inverse scattering problem (ISP) is considered within the framework of two-particle scattering for local interaction case depending only on the scattering between particles. Constructing the solution of secondary integral equation solution of ISP is described in the clear image. Numerical calculations are conducted using a direct method. 4 refs.; 1 tab.

39635 (JINR-D–17-88-95, pp. 241-245) **Nonstandard algebras of creation and annihilation operators.** Kuryshkin, V.V. (Joint Inst. for Nuclear Research, Dubna (USSR)); Entralgo, E.E. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. (In Russian). (CONF-8708341–: 4. International symposium on selected topics in statistical mechanics, Dubna, USSR, 25-29 Aug 1987). In *4. International symposium on selected topics in statistical mechanics.* Order Number DE89012150/JAW. Available from NTIS (US Sales Only), PC A21/MF A01; INIS.

Non-standard algebras of creation and annihilation operators are considered. A general definition of creation and annihilation operator algebra, allowing one to plott different algebras proceding from unified principles, is proposed. The plotting is demostrated taking A(1) operator algebras in finite-dimensional complex spaces of γ>vector with scalar product $\langle\gamma\,\gamma'\rangle=\langle\gamma'\gamma\rangle^*$ at $\langle\gamma'\gamma\rangle \geq 0$ as an example. 33 refs.

39636 (JINR-D–17-88-95, pp. 397-404) **Local quantum-mechanical momentum balance and its consequencies. Force sum rules and stress formulae.** Zieche, P. (Technische Univ., Dresden (German Democratic Republic)); Diener, G.; Graafenstejn, J.; Kaschner, R.; Nielsen, O.H. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. (CONF-8708341–: 4. International symposium on selected topics in statistical mechanics, Dubna, USSR, 25-29 Aug 1987). In *4. International symposium on selected topics in statistical mechanics.* Order Number DE89012150/JAW. Available from NTIS (US Sales Only), PC A21/MF A01; INIS.

Many-electron systems are considered within Born-Oppenheimer approximation. The balance equation is derived; its first application concerns force sum rules, involving alternative possibilities for the calculation of relaxation forces. An extended crystal with force-free bulk atoms but under a non-vanishing stress is considered. 25 refs.

39637 (JINR-D–17-88-95, pp. 423-433) **Theory of areal objects.** Shavokhina, N.S. (Joint Inst. for Nuclear Research, Dubna (USSR)). Joint Inst. for Nuclear Research, Dubna (USSR). 1988. (In Russian). (CONF-8708341–: 4. International symposium on selected topics in statistical mechanics, Dubna, USSR, 25-29 Aug 1987). In *4. International symposium on selected topics in statistical mechanics.* Order Number DE89012150/JAW. Available from NTIS (US Sales Only), PC A21/MF A01; INIS.

Areal models of relativistic space-limited objects are considered. It is shown that Affine conncetion spacetime has a reacher structure as compared to differential multiplicity and allows one to introduce new physical objects as, for example, gauge fields. All areal objects in spacetime, where the areas of all of the surfaces can be measured are enumerated. 26 refs.

39638 (JINR-R-2-88-454) **Reduction of the Dirac equation to the Dirac-Kaehler equation.** Pestov, A.B.; Satikov, I.A.; Strazhev, V.I. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics. 1988. 4p. (In Russian). Order Number DE89630111/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Submitted to the journal Zh. Teor. Mat. Fiz.

Relation is established between spinors of the space of dimensionality d=2 m and antisymmetric tensors of the space of dimensionality d=m. It is shown that there exists a dimensional reduction of the Dirac equation to the Dirac-Kahler equation. 17 refs.

39639 (SAND-88-0259C) **A Green's function solution for a rectangular heat source on an infinite plate.** Bainbridge, B.L. Sandia National Labs., Albuquerque, NM (USA). 1989. 19p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890819-4: ASME/AIChE national heat transfer conference, Philadelphia, PA, USA, 6-9 Aug 1989). Order Number DE89007425/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The applications associated with a rectangular heat source on an infinite plate range from integrated circuits to thin film heat flux sensors on thin substrates. The particular problem for which the solution is developed concerns the use of a resistive strip for monitoring currents generated in circuits exposed to electromagnetic fields. The Green's function formulation is solved by using early and late time approximations for which analytical solutions can be derived. Expressions are developed for three sets of boundary conditions and compared to the experimental performance of a physical device. 13 refs., 4 figs.

39640 (UWThPh-1988-36) **On quantum holonomy for mixed states.** Dabrowski, L.; Grosse, H. Vienna Univ. (Austria). Inst. fuer Theoretische Physik. 1988. 7p. Order Number DE89630112/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

There is a natural connection and parallel transport on the Hilbert tensor product HxH (or equivalently the space of Hilbert-Schmidt operators), the elements of which represent density matrices in H up to unitary operators. We postulate a time evolution equation, which leads to this connection after extracting a proper 'dynamical' unitary phase. As an example, we compute the holonomy of a loop of temperature states for the spin in a rotating magnetic field. 9 refs.

39641 (UWThPh-1988-40) **Quantum K-systems.** Narnhofer, H.; Thirring, W. Vienna Univ. (Austria). Inst. fuer Theoretische Physik. 1988. 15p. Order Number DE89630113/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

We generalize the classical notion of a K-system to a noncommutative dynamical system by requiring that an invariantly defined memory loss be 100%. We give some examples of quantum K-systems and show that they cannot contain any quasiperiodic subsystem. 13 refs.

39642 (UWThPh-1988-42) **Examples of algebrae with equal dynamic entropy.** Narnhofer, H. Vienna Univ. (Austria). Inst. fuer Theoretische Physik. 1988. 12p. (In German). Order Number DE89630114/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

For given dynamical entropy we construct uncountably many examples of corresponding algebras, some of them are quantum K systems, whereas at least one explicit example is not. Consequences for cluster properties are studied. 12 refs.

39643 (UWThPh-1989-1) **Local differential geometry of null curves in conformally flat space-time.** Urbantke, H. Vienna Univ. (Austria). Inst. fuer Theoretische Physik. 1989. 15p. Order Number DE89630127/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The conformally invariant differential geometry of null curves in conformally flat space-times is given, using the six-vector formalism which has generalizations to higher dimensions. This is then paralleled by a twistor description, with a twofold merit: firstly, sometimes the description is easier in twistor terms, sometimes in six-vector terms, which leads to a mutual enlightenment of both; and secondly, the case of null curves in timelike pseudospheres or 2+1 Minkowski space we were only able to treat twistorially, making use of an invariant differential found by Fubini and Cech. The result is the expected one: apart from stated exceptional cases there is a conformally invariant parameter and two conformally invariant curvatures which, when specified in terms of this parameter, serve to characterize the curve up to conformal transformations. 12 refs.

39644 (UWThPh-1989-5) **Dynamical entropy, quantum K-systems and clustering.** Narnhofer, H. Vienna Univ. (Austria). Inst. fuer Theoretische Physik. 1989. 10p. Order Number DE89630116/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The two possibilities to define a quantum K-system, either using algebraic relations or using properties of the dynamical entropy, are compared. It is shown that under the additional assumption of strong asymptotic abelianess the algebraic relations imply the properties of the dynamical entropy. 14 refs.

39645 (UWThPh-1989-11) **New approach to the understanding of level ordering in atoms and nuclei.** Baumgartner, B.; Pflug, A. Vienna Univ. (Austria). Inst. fuer Theoretische Physik. 1989. 12p. Order Number DE89630115/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The shell structures of the states of a hydrogen atom and of a harmonic oscillator are treated as special cases of supersymmetric quantum mechanics. The splitting of energy levels in nuclei and for electrons in heavier atoms can be understood as brought about by special breaking of the supersymmetry, which implies the observed level ordering. 10 refs., 5 figs.

39646 **Higher-order hybrid Monte Carlo algorithms.** Creutz, M. (Physics Department, Rutgers Universtiy, Piscataway, New Jersey 08855(US)); Gocksch, A. *Physical Review Letters (USA)*, 63(1): 9-12 (3 Jul 1989). DOE Contract AC02-76CH00016.

We present a simple recursive iteration of the leapfrog discretization of Newton's equations which leads to a removal of the finite-step-size error to any desired order. This is done in a manner that preserves phase-space areas and reversibility, as required for use in the hybrid Monte Carlo method for simulating fermionic fields. The resulting asymptotic volume dependence is $\exp[(\ln V)^{1/2}]$. We test the scheme on the (2+1)-dimensional Hubbard model.

39647 **Ewald methods in molecular dynamics for systems of finite extent in one of three dimensions.** Rhee, Y. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455(US)); Halley, J. W.; Hautman, J.; Rahman, A. *Physical Review [Section] B: Condensed Matter (USA)*, 40(1): 36-42 (1 Jul 1989).

We describe a new method for the treatment of molecular-dynamics computersimulation for systems with long-range interactions when the system to besimulated is only infinite in two of the dimensions of the three-dimensionalspace. Such problems arise, for example, in the study of surfaces. We report amethod to deal with these problems based on Ewald techniques but involvingseveral new features. Numerical tests show that our methods are fast andaccurate enough to be feasible for study of the systems of interest, though notquite as fast as the corresponding techniques for bulk systems. We reportresults of a simulation of water between two dielectric walls using the newmethods.

39648 **Phenomenological gravitational constraints on strings and higher-dimensional theories.** Kostelecky, V. A. (Physics Department, Indiana University, Bloomington, Indiana 47405(US)); Samuel, S. *Physical Review Letters (USA)*, 63(3): 224-227 (17 Jul 1989).

We investigate measurable gravitational and cosmological effects in four dimensions that can arise from the compactification of higher-dimensional theories incorporating gravity. We identify the nature of effects due to massless scalar components of the compactified higher-dimensional metric and due to modifications of cosmological dynamics. Current experimental data impose constraints on the viability of many higher-dimensional theories, including Kaluza-Klein, supergravity, and string theories. The phenomenological problems can be avoided if the components of the metric in the higher dimensions acquire an effective mass. We survey some possible mechanisms for mass generation.

39649 Comment on "Bistability and colored noise in nonequilibrium systems: Theory versus precise numerics". Tsironis, G. P. (Institute for Nonlinear Science, R-002, University of California, San Diego, La Jolla, California 92093 Department of Chemistry, B-040, University of California, San Diego, La Jolla, California 92093(US)); Lindenberg, K.; Peacock-Lopez, E. *Physical Review Letters (USA),* 63(2): 214-214 (10 Jul 1989).

A Comment on the Letter by P. Jung and P. Hänggi, Phys. Rev. Lett. 61, 11 (1988).

39650 Tsironis *et al.* reply. Tsironis, G. P. (Institute for Nonlinear Science, R-002 and Department of Chemistry, B-040, University of California, San Diego, La Jolla, California 92093 Dipartimento di Fisica e Gruppo Nazionale di Struttura della Materia, Universita degli Studi di Pisa *Physical Review Letters (USA),* 63(2): 217-217 (10 Jul 1989).

A reply to the comment color–induced transition to a non–convensional diffusion regime is presented.It is pointed out that the approach referred in the comment has the additional shortcoming of not providing exact dyn– amical properties. (AIP)

39651 Possible effect of the local terrain on the Australian fifth-force measurement. Bartlett, D. F. (Department of Physics, University of Colorado, Boulder, Colorado 80309-0390(US)); Tew, W. L. *Physical Review [Section] D: Particles and Fields (USA),* 40(2): 673-675 (15 Jul 1989).

We believe that the local topography can account for most of the positive evidence for non-Newtonian gravity recently reported by Stacey and co-workers. We show that the Hilton mine site in Queensland, Australia, is effectively in a valley and speculate on how this feature could have been missed in the original analysis.

39652 Model of adaptive temporal development of structured finite systems. Patera, J. (Centre de Recherches Mathematiques Appliquees, Universite de Montreal, Montreal, Quebec, Canada H3C 3J7 (CA)); Shaw, G. L.; Slansky, R.; Leng, X. *Physical Review [Section] A: General Physics (USA),* 40(2): 1073-1087 (15 Jul 1989).

The weight systems of level-zero representations of affine Kac-Moody algebras provide an appropriate kinematical framework for studying structured finite systems with adaptive temporal development. Much of the structure is determined by Lie algebra theory, so it is possible to restrict greatly the connection space and analytic results are possible. The time development of these systems often evolves to cyclic temporal-spatial patterns, depending on the definition of the dynamics. The purpose of this paper is to set up the mathematical formalism for this "memory in Lie algebras" class of models. An illustration is used to show the kinds of complex behavior that occur in simple cases.

39653 Huygens–Fresnel–Kirchoff wave-front diffraction formulation: spherical waves. Kraus, H. G. (Idaho National Engineering Laboratory, EG&G Idaho, Incorporated, P.O. Box 1625, Idaho Falls, Idaho 83415(US)). *Journal of the Optical Society of America A: Optics and Image Science (USA),* 6(8): 1196-1205 (Aug 1989). DOE Contract AC07-76ID01570.

The Huygens–Fresnel diffraction integral has been formulated for incident spherical waves with use of the Kirchhoff obliquity factor and the wave front as the surface of integration instead of the aperture plane. Accurate numerical integration calculations were used to investigate very-near-field diffraction for the well-established case of a circular aperture. It is shown that the classical aperture-plane formulation degenerates when the wave front, as truncated at the aperture, has any degree of curvature to it, whereas the wave-front formulation produces accurate results from ∞ up to one aperture diameter behind the aperture plane. It is also shown that the Huygens–Fresnel–Kirchhoff incident-plane-wave–aperture-plane-integration and incident-spherical-wave–wave-front-integration formulations produce equally accurate results for apertures with exit *f*-numbers as small as 1.

39654 Scaling of fractal basin boundaries near intermittency transitions to chaos. Park, B. (Laboratory for Plasma Research and Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742(US)); Grebogi, C.; Ott, E.; Yorke, J. A. *Physical Review [Section] A: General Physics (USA),* 40(3): 1576-1581 (1 Aug 1989).

It is the purpose of this paper to point out that the creation of fractal basin boundaries is a characteristic feature accompanying the intermittency transition to chaos. (Here "intermittency" transition is used in the sense of Pomeau and Manneville [Commun. Math. Phys. 74, 189 (1980)]; viz., a chaotic attractor is created as a periodic orbit becomes unstable.) In particular, we are here concerned with type-I and type-III intermittencies. We examine the scaling of the dimension of basin boundaries near these intermittency transitions. We find, from numerical experiments, that near the transition the dimension scales with a system parameter p according to the power law $d \geq d_0 - k|p-p_t|^{\beta}$ with $\beta=1/2$, where d_0 is the dimension at the intermittency transition parameter value $p=p_t$ and k is a scaling constant. Furthermore, for type-I intermittency $d_0 < D$, while for type-III intermittency $d_0=D$,where D is the dimension of the space. Heuristic analytic argumentssupporting the above are presented.

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Refer also to citation(s) 38258, 39012, 39699, 39706, 39744, 39745, 39746, 39747, 39748, 39749, 39750, 39751

39655 (CONF-890498–1) **$T n \tau_E$ comparisons of tokamak reactors of different aspect ratios.** Peng, Y.K.M. Oak Ridge National Lab., TN (USA). 1989. 20p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From Annual controlled fusion theory conference: international Sherwood theory meeting; San Antonio, TX, USA; 3-5 Apr 1989. Order Number DE89013057/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The ignition parameter $T n \tau_E$ of the International Tokamak Experimental Reactor (ITER) with an aspect ratio A = 2.6, a major radius R = 5.8 m, a plasma current I_p = 22 MA, and an external toroidal field of B_{t0} = 5 T at R; a High Field Experimental Reactor (HFER) with A = 6.0, R = 6.0 m, I_p = 8.2 MA, and B_{t0} = 12.4 T; and a Spherical Torus Experimental Reactor (STER) with A = 1.2, R = 1.5 m, I_p = 22 MA, and B_{t0} = 0.88 T are compared using a set of presently popular empirical or semi-empirical confinement scaling expressions. Since the physics basis for these scaling expressions are not determined, the results of comparison are best suited to helping identify issues critical to furthering our understanding of tokamak confinement. In the case where the plasma pressure is limited by the Troyon beta scaling using B_{t0}, the scaling expressions with relatively strong A-dependence, favor the HFER, while those with relatively strong I_p-dependence favor the STER or suggest comparable $T n \tau_E$. In the case where the plasma pressure is determined by a second stability $\epsilon\beta_p$ limit (ϵ = 1/A), the projections of the T-10 Goldston, Odajima-Shimamura, and Rebut-Lallia scaling expressions are also compared. There it is found that the above STER and HFER would suffice if $\epsilon\beta_p$ = 0.5. These varied projections highlight the uncertain I_p, A and R dependencies in empirical tokamak confinement scaling, which are likely to be resolved only by tests at very low and high A. The results also indicate that whether the plasma pressure is determined by a high $\epsilon\beta_p$ limit is critical to the viability of the HFER and the STER compared to ITER, even if the above confinement uncertainties remain. 5 tabs.

39656 (DOE/ER/53221–4) **Maryland controlled fusion research program: Progress report, November 1, 1988–October 31, 1989.** Griem, H.R.; Liu, C.S. Maryland Univ., College Park, MD (USA). Lab. for Plasma Research. Jul 1989. 18p. Sponsored by DOE Energy Research. DOE Contract FG05-86ER53221. Order Number DE89015125/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In recent years, members of the Maryland Plasma Theory Group have made significant contributions to the national fusion theory programs, and, in many cases, these theoretical developments helped to interpret experimental results and to design new experimental programs. In the following, we summarize the technical progress in four major areas: density limit disruptions and sawteeth in tokamaks; anomalous transport in tokamaks; L/H Transition in tokamaks; and magnetic reconnection in compact torus and REP. 9 refs.

39657 (EUR–11705, pp. 69-78) **Resistive ballooning modes in stellarator geometry.** Wobig, H. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)); Scardovelli, R. Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

It is shown that if the growth rate is real, the equations of resistive ballooning modes can be analyzed by methods of functional analysis. In the limit of zero compressibility, the resistive ballooning mode is unstable for any plasma pressure. The threshold of the pressure gradient for the onset of ideal ballooning modes is lowered by finite resistivity. Finite compressibility can stabilize resistive ballooning modes. Stability against resistive ballooning modes improves with the number of field periods. Stellarators with five field periods and aspect ratio 10 show similar ballooning mode effects as tokamaks with aspect ratio 5 and q(a) = 3-2.

39658 (EUR–11705, pp. 431-438) **Transport in ergodic magnetic fields.** Feneberg, W. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

Solution of a 3D problem based on a numerical treatment of macroscopic fluid equations is shown to be necessary to describe a stochastic scrape-off layer in the framework of the theory of transport in an ergodic magnetic field. The transport of a stochastic magnetic field within the bulk plasma is also considered. Here the drift kinetic equation is solved with the ansatz for the distribution function to deviate only a little from the Maxwellian. A local fluctuating stochastic magnetic field and electric field are considered and transport is found by averaging over the unperturbed magnetic surfaces. Due to collisions the diffusion coefficient is much larger than given by the Rosenbluth, Rechester formula.

39659 (EUR–11705, pp. 439-450) **Perturbed magnetic fields as Hamiltonian problem.** Montvai, A. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

The promising field of the Hamiltonian description of a field of vectors representing a magnetic field defined over a compact manifold (such as for instance the case of a toroidal confinement system) has been greatly handicapped by the fact, that there has not been any effective numerical procedure to describe a given nonsymmetric configuration. In this paper at first a brief analysis of the existing derivations of the Hamiltonian properties of the toroidal confinement systems is given. It is shown, that these formal derivations are affected by mathematical problems, which prevents them to be sufficiently general and reliable. After this a proof with strict mathematical backgrounds is briefly described, and a numerical procedure is sketched, which represents a given perturbed magnetic field by its Hamiltonian generating function. Finally an illustrative example shows the applicability of the procedure.

39660 (INIS-mf–11480, pp. 27-28) **Synchrotron radiation in plasma physics.** Nassri, A.; Heindler, M. Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik. Nov 1988. In *Annual report of the Institute for Theoretical Physics in Graz, Austria.* Order Number DE89631627/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

PLASMA/synchrotron radiation; PLASMA/thermonuclear devices; ABSORPTION; ASTROPHYSICS; EMISSION; PLASMA; PROGRESS REPORT; S CODES; SCALING LAWS

39661 (INIS-mf–11480, pp. 29-30) **Magnetic field annihilation in three-dimensional viscous flows.** Heindler, M. Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik. Nov 1988. In *Annual report of the Institute for Theoretical Physics in Graz, Austria.* Order Number DE89631627/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

PLASMA/viscous flow; ELECTRIC FIELDS; MAGNETIC FIELDS; PLASMA; PROGRESS REPORT; VORTICES

39662 (INIS-mf–11480, pp. 21-22) **Fusion reactor studies. ARIES, field reversed configurations, burning control in ITER.** Kernbichler, W.; Heindler, M. Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik. Nov 1988. (In German). In *Annual report of the Institute for Theoretical Physics in Graz, Austria.* Order Number DE89631627/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

THERMONUCLEAR REACTORS/plasma confinement; PROGRESS REPORT

39663 (IPNO-DRE–88-14) **Interaction of heavy ion beams with a hydrogen plasma: plasma lens effect and stopping power enhancement.** Gardes, D.; Bimbot, R.; Della-Negra, S.; Dumail, M.; Kubica, B.; Richard, A.; Rivet, M.F.; Servajean, A.; Fleurier, C.; Sanba, A. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1988. 12p. Order Number DE89789222/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

By coupling a hydrogen plasma to a Tandem accelerator, transmission and energy losses of 2 MeV/u carbon and sulfur beams passing through a plasma target have been investigated. Fluctuations in beam transmission have been observed and attributed to a plasma lens effect. Moreover, energy loss measurements indicate an enhanced stopping power of the plasma relative to its cold matter equivalent.

39664 (JAERI-M–88-231) **Annual report of the Naka Fusion Research Establishment for the period of April 1, 1987 to March 31, 1988.** Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1988. 394p. Order Number DE89790776/JAW. Available from NTIS (US Sales Only), PC A17/MF A01.

Research and development activities of the Naka Fusion Research Establishment for the period of April 1987 to March 1988 are described. In JT-60, the plasma heating experiment aiming at a reactor-grade plasma was started in June 1987, after completing the integrated performance test of NBI and RF heating systems with the tokamak machine, most of the first wall being replaced to carbon tiles from titanium-carbide films. Enphasis was placed in the experiment on increasing the plasma current together with the optimization of plasma control and heating. The steady improvement of plasma performance lead finally in September reactor-grade plasma parameters, which were located inside the region depicted by the Atomic Energy Commission at the start of the JT-60 project. In JFT-2M and Doublet III-D, extensive experiments revealed detailed phenomenology of H-mode transition and its characteristics. The test of a prototype turbo molecular pump with a ceramic rotor driven by gas turbine was successfully completed. In the development of negative ion sources, steady improvement was made in the efficiency of negative ion formation and beam extraction. In the RF technology, test-fabricated 120 GHz gyrotron worked well. The Demo Poloidal Coil program was progressed as scheduled. The coils, two NbTi and one Nb_3Sn, were under fabrication. The large cryogenic system was completed by sharing the JT-60 power supply. In the Tritium Process Laboratory, installation into glove boxes was completed in March 1988 of various experimental apparatus, i.e., fuel clean-up system, cryogenic distillation and thermal diffusion systsms for hydrogen isotope separation etc. In the reactor design study, recapitulation and review of FER design for last two years were made.

39665 (JET-R–88-16) **Plasma equilibria and stationary flows in axisymmetric systems. Pt. 1.** Zelazny, R.; Stankiewicz, R.; Potempski, S. Commission of the European Communities, Abingdon (UK). JET Joint Undertaking. May 1988. 92p. Order Number DE89630499/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

During discharges within a tokamak device such as JET fluctuations are observed in the plasma, of plasma density, temperature, electric potential and of the magnetic field. These fluctuations have complicated structure and are linked with different kinds of instabilities. However, it is not clear which instabilities are most important in

determining the behaviour of the plasma. A comprehensive numerical theory which can predict the effect of the instabilities on the transport of plasma in axisymmetric systems has been sought using the static Grad-Shafranov-Schlueter (SGSS) equation as a basis. However, the static equation was over simplified for the situation in JET with additional heating giving rise to large toroidal flows, and an extended equation (EGSS) was developed. The results of the study include the discovery of algebraic branches of solutions to the EGSS equation even for very small poloidal flows, solutions to the inverse problem for the SGSS and EGSS equations using Fourier decomposition, classification of the boundary condition at the magnetic axis, demonstration of a visible effect of the poloidal flow on the separation of the density surface and the magnetic surface an indication of the existence of multiple branches of solutions to the EGSS and SGSS equations and their relation to stability properties. (U.K.).

39666 (JET-R–88-17) **Plasma equilibria and stationary flows in axisymmetric systems. Pt. 2. Supplement (Listing of the program for solving the EGSS equations).** Zelazny, R.; Stankiewicz, R.; Potempski, S. Commission of the European Communities, Abingdon (UK). JET Joint Undertaking. May 1988. 53p. Order Number DE89630500/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

Part I of this report described the computational problems connected with the bifurcating solutions to static and extended Grad-Shafranov-Schlueter equations (with stationary flows). Part II is a listing of the computer program for solving the extended Grad-Shafranov-Schlueter equations developed in Part I.

39667 (JET-R–89-01) **SWAN coupling code: user's guide.** Litaudon, X.; Moreau, D. Commission of the European Communities, Abingdon (UK). JET Joint Undertaking. Nov 1988. 46p. Order Number DE89630501/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Coupling of slow waves in a plasma near the lower hybrid frequency is well known and linear theory with density step followed by a constant gradient can be used with some confidence. With the aid of the computer code SWAN, which stands for 'Slow Wave Antenna', the following parameters can be numerically calculated: $n_{parallel}$ power spectrum, directivity (weighted by the current drive efficiency), reflection coefficients (amplitude and phase) both before and after the E-plane junctions, scattering matrix at the plasma interface, scattering matrix at the E-plane junctions, maximum electric fields in secondary waveguides and location where it occurs, effect of passive waveguides on each side of the antenna, and the effect of a finite magnetic field in front of the antenna (for homogeneous plasma). This manual gives the basic information on the main assumptions of the coupling theory and on the use and general structure of the code itself. It answers the questions what are the main assumptions of the physical model? how to execute a job? what are the input parameters of the code? and what are the output results and where are they written?

39668 (KEK–88-7, pp. 66-73) **Negative ion sources for fusion plasma diagnostics.** Sasao, M. (Nagoya Univ. (Japan). Inst. of Plasma Physics). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Oct 1988. (CONF-8804288–: Symposium on negative ion sources and their applications, Tsukuba, Japan, 5-6 Apr 1988). In *Proceedings of the symposium on negative ion sources and their applications.* Order Number DE89012159/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

Alpha particle diagnostics requires a high current negative ion beam. Alpha particles, produced through DT reaction at an energy of 3.5 MeV, have an important role in sustaining the burning. Most of them are trapped in the plasma, slow down by collision with plasma electrons and ions, and heat up the plasma. Measurement of the confined alpha particle velocity distribution and its time and space evolution is indispensable to reveal the mechanism of alpha-particle confinement. Two methods using high energy neutral beams are considered effective. One of them uses a one-electron process to determine the alpha particle velocity distribution from a detected doppler profile of decaying photons. The other uses a two-electron capture process through which alpha particles are neutralized and escape from the plasma to be detected. A surface conversion He^- source is currently under development at Nagoya University. It is a multicups bucket source with a converter at the center. When cesium vapor is introduced to lower the work function of the converter surface, a small peak sometimes occurs at the position of He^- in the magnetic momentum separator. The peak is consistent with that of mass=4 self-extracted with an energy of the converter voltage. Fundamental experiments of Li^- surface production by a sputtering process have been carried out at Doshisha University. (N.K.).

39669 (KEK–88-7, pp. 163-180) **Development of monitoring method for the work function on the converter surface in a negative ion source plasma.** Yamaoka, Hitoshi (Nagoya Univ. (Japan). Inst. of Plasma Physics); Sasao, Mamiko; Wada, Motoi; Ramos, H.J. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Oct 1988. (CONF-8804288–: Symposium on negative ion sources and their applications, Tsukuba, Japan, 5-6 Apr 1988). In *Proceedings of the symposium on negative ion sources and their applications.* Order Number DE89012159/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

A monitoring method of surface work function on a converter of a negative ion source is developed by measuring photoelectron emission induced by laser irradiation. Negative ions self-extracted are compared with the photoelectron current for hydrogen and helium discharges. The photoelectron current induced by the Ar^+ laser gives overall behavior of the change in the cesium coverage, and the work function. The dye laser is used to confirm the region of the work function minimum.

39670 (KIYI–88-9) **Beam-plasma discharge in penetrating plasma.** Opanasenko, A.V.; Pitatelev, G.V.; Romanyuk, L.I. AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. 24p. (In Russian). Order Number DE89630481/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The beam-plasma interaction in plasma penetrating towards an electron beam injected into the symmetrically opened penning type plasma system is investigated. The ignition of the beam-plasma discharge by upper hybrid wave excited by the electron beam is found. The behaviours of the amplitude-frequency spectra, oscillation localizations and steady-state plasma parameters while the the beam-plasma discharge developping are determined. It is shown that the strong relaxation of the energy spectrum of beam electrons and the heating of plasma electrons occure in the beam-plasma discharge region. The beam-plasma discharge is determined to be nonstationary and relaxation behaviour. 21 refs.; 19 figs.

39671 (UCLA/PPG–1171, pp. 23, Paper 2) **Presheath profiles in simulated tokamak edge plasmas.** Labombard, B.; Conn, R.W.; Hirooka, Y.; Lehmer, R.; Leung, W.K.; Nygren, R.E.; Ra, Y.; Tynan, G. California Univ., Los Angeles, CA (USA). Plasma Physics Group. Aug 1988. In *PISCES and ALT-II: Juelich PSI papers.* Order Number DE88017301/JAW. Available from NTIS, PC A06/MF A01.

The PISCES plasma surface interaction facility at UCLA generates plasmas with characteristics similar to those found in the edge plasmas of tokamaks ($n = 10^{11}$-10^{13} cm^{-3}, $T_e = 3$ - 30 eV). Steady state magnetized plasmas produced by this device are used to study plasma-wall interaction phenomena which are relevant to tokamak devices. We report here progress on some detailed investigations of the presheath region that extends form a wall surface into these simulated tokamak edge plasma discharges along magnetic field lines. A number of edge plasma diagnostics have been specially developed for this work and are now becoming fully operational including a fast-scanning multiple Langmuir/Emissive/Mach probe system and a CID camera imaging system. Both systems allow detailed diagnoses of a 10x10x10 cm^3 region of magnetized plasma in contact with a wall surface. Measurements of plasma density, electron temperature, floating potential, space potential, and bulk plasma flow velocities have been obtained in hydrogen, helium, and argon plasmas with densities ranging from 10^{12} to 10^{13} cm^{-3}, electron temperatures from 5 to 15 eV, and axial magnetic fields of 0.2 to 1.4 kG.

39672 (UCLA/PPG–1171, pp. 16, Paper 3) **Erosion and redeposition behavior of selected NET-candidate materials under high-flux hydrogen, deuterium plasma bombardment in PISCES.** Franconi, E.; Hirooka, Y.; Conn, R.W.; Leung, W.K.; LaBombard, B.; Nygren, R.E. California Univ., Los Angeles, CA (USA). Plasma Physics Group. Aug 1988. In *PISCES and ALT-II:*

Juelich PSI papers. Order Number DE88017301/JAW. Available from NTIS, PC A06/MF A01.

Plasma erosion and redeposition behavior of selected candidate materials for plasma-facing components in the NET-machine have been investigated using the PISCES-A facility. Materials studied include SiC-impregnated graphite, 2D graphite weaves with and without CVD-SiC coatings, and isotropic graphite. These specimens were exposed to continuous hydrogen or deuterium plasmas under the following conditions: electron temperature range from 5 to 35eV; plasma density range from $5x10^{11}$ to $1x10^{12}$ cm^{-3}; flux range from $5x10^{17}$ to $2x10^{18}$ ions $cm^{-2}s^{-1}$; fluence of the order from 10^{21} to 10^{22} ions/cm^2; bombarding energies of 50 and 100eV; target temperature range from 300 to 1000°C. The erosion yield of SiC-impregnated graphite due to deuterium plasma bombardment is found to be a factor of 2 to 3 less than that of isotropic graphite materials. A further factor of 2-3 reduction in the erosion yield is observed in when redeposition associated with reionization of sputtered particle becomes significant. From postbombardment surface analysis with AES, the surface composition in terms of the Si/C of SiC-impregnated graphite ratio is found to increase from 0.15 to 0.7 after hydrogen plasma bombardment to a fluence around 4×10^{21} ions/cm^2 at 350°C. However, the final surface composition appears to remain unchanged up to 4×10^{22} ions/cm^2, the highest fluence in the present study. Significant surface morphological modifications of SiC-impregnated graphite are observed after the high-fluence plasma exposure. Several structural problems such as coating-substrate adhesion have been pointed out for SiC-coated 2D graphite weave.

39673 Long pulse laser-plasma interactions. Kruer, W.L. (Univ. of California, Lawrence Livermore National Lab., P.O. Box 808, Livermore, CA (US)). v.v of High intensity laser-matter interactions. Campbell, E.M.; Baldis, H. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-8801117–: High intensity laser matter interactions, Los Angeles, CA, USA, 12-13 Jan 1988).

The absorption of intense laser light in plasmas with a long density scale length can be influenced by many different processes, ranging from collisional absorption to laser-driven instabilities. The mix of these coupling processes depends strongly on the collisionality of the plasma. Optimum coupling is obtained by the use of short wavelength laser light.

39674 The influence of free electrons on the propagation of intense subpicosecond 248 nm radiation in hydrogen plasmas. Luk, T.S. (Lab. for Atomic, Molecular, and Radiation Physics, Dept. of Physics, Univ. of Illinois at Chicago, P.O. Box 4348, Chicago, IL (US)); Pan, X.J.; Solem, J.C.; Boyer, K.; Rhodes, C.K. v.v of High intensity laser-matter interactions. Campbell, E.M.; Baldis, H. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-8801117–: High intensity laser matter interactions, Los Angeles, CA, USA, 12-13 Jan 1988).

Studies of the spectral and spatial properties of propagation of intense (– 10^{16} W/cm^2) subpicosecond 248 nm radiation in hydrogen plasmas for electron densities in the 10^{18}-10^{19} cm^{-3} range are reported. The influence of the ponderomotive potential on the character of the propagation is considered.

39675 Effects of ISI on the interaction of 1.05 μm light with high Z plasmas. Kania, D.R. (Lawrence Livermore National Lab., Livermore, CA (US)); Bell, P.; Obenschain, S.P. v.v of High intensity laser-matter interactions. Campbell, E.M.; Baldis, H. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-8801117–: High intensity laser matter interactions, Los Angeles, CA, USA, 12-13 Jan 1988).

A systematic increase in the x-ray yield from the ISI interactions over the non-ISI interactions was observed. The signal amplitudes in channel one increased by 30% and the signal levels in channel two increased by 10% when normalized to the incident laser energy. The hard x-ray signals exhibited the opposite effect, the signal level decreased by 40%. The scattered laser light signals also decreased with ISI, but the scattered laser light levels and hard x-ray yields were small enough to indicate that these changes were not the cause of the increase in x-ray yield. The results are consistent with the measurements of scattered light and hard x-ray production of Obenschain et. al. with 0.53 μm light on plastic targets and are opposite their 1.05 μm results. This is a direct result of the increased collisionality of the gold targets for 1.05 μm light over the plastic targets resulting from the higher z of the plasma. As a result, the laser light absorption (collisional absorption) profile for the 1.05 μm interactions in gold more closely resemble the 0.53 μm interactions in plastic targets with less laser light reaching the critical surface to excite instabilities.

39676 Test particle injection in the relativistic plasma waves excited by two co-propagating laser beams. Joshi, C. (Univ. of California, Los Angeles, CA (US)); Clayton, C.E.; Marsh, K.; Leemans, W.; Williams, R.; Shu, M. v.v of High intensity laser-matter interactions. Campbell, E.M.; Baldis, H. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-8801117–: High intensity laser matter interactions, Los Angeles, CA, USA, 12-13 Jan 1988).

The authors report on a series of experiments aimed at the demonstration of controlled acceleration of externally injected test particles (electrons) by a relativistic plasma wave. The plasma wave is excited resonantly by beating two co-propagating laser beams at the plasma frequency. The first part of the paper describes the electron linear accelerator and the beam transport system, as well as the particle detection system. The electron macropulse energy spectrum and beam emittance are measured and are shown to be consistent with the requirements of the experiment. The electron beam is passed through a Θ-pinch plasma. Although Raman scattering of the incident CO_2 laser has shown the plasma to be reproducible in density to within 15% from one shot to the next at peak compression, direct evidence of localized density inhomogeneities due to trapped magnetic fields is found via the deflection of the injected electron beam.

39677 X-ray reflectivity of a rapidly heated multilayer structure. Zigler, A. (Dept. of Plasma Physics, Soreq Nuclear Research Center, Yavne 70600 (IL)); Falcone, R.W.; Underwood, J.H. v.v of High intensity laser-matter interactions. Campbell, E.M.; Baldis, H. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-8801117–: High intensity laser matter interactions, Los Angeles, CA, USA, 12-13 Jan 1988).

The spacing of layers in a sputtered, multilayer structure was rapidly and permanently increased by heating with a nanosecond laser pulse. During laser heating, the Bragg angle decreased and the peak reflectivity increased for diffraction of soft x-ray radiation at 4.4 nm. Measurements were made using a time and space resolving x-ray streak camera detector. The streak camera records the intensity of the 4.4 nm radiation as diffracted from the multilayer, with one axis indicating time and the other axis spatially resolving the scattered light and indicating the Bragg angle, or equivalently, lattice spacing. During the experiment part of the multilayer is heated using an Nd:YAG laser pulse (1.06 μm, 7 nsec) focused to a 4 mm spot at an energy density of 0.4 ± 1.2 J/cm^2 and delayed by several nanoseconds from the laser producing the 4.4 nm radiation.

39678 Resonantly-enhanced, four-photon ionization of krypton at laser intensities exceeding 10^{13} W/cm^2. Perry, M.D. (Lawrence Livermore National Lab., P.O. Box 5508, L-473, Livermore, CA (US)); Landen, O.L.; Campbell, E.M. v.v of High intensity laser-matter interactions. Campbell, E.M.; Baldis, H. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-8801117–: High intensity laser matter interactions, Los Angeles, CA, USA, 12-13 Jan 1988).

The yield of singly- and multiply-charged ions of krypton and xenon is presented as a function of laser intensity and frequency. The measurements were performed using the second harmonic output of a well-characterized, tunable picosecond dye laser in the range 285 to 310 nm at laser intensities from $1x10^{12}$ to 10^{14} W/cm^2. Enhancement of the Kr^+ yield by two orders of magnitude by three-photon resonant, four-photon ionization is observed in the vicinity of the $4d'[5/2]_3$ and the $4d[3/2]_1$ intermediate states. A model incorporating line shifts and widths scaling linearly with intensity is in good agreement with the experimental results.

39679 High-pressure laser-fusion compression results. McCrory, R.L. (Lab. For Laser Energetics, Univ. of Rochester, 250 E. River Rd., Rochester, NY (US)); Soures, J.M.; Verdon, C.P.; Audebert, P.; Bradley, D.; Delettrez, J.; Hutchison, R.; Jacobs, S.D.;

Jeanimagi, P.; Keck, R. v.v of High intensity laser-matter interactions. Campbell, E.M.; Baldis, H. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-8801117–: High intensity laser matter interactions, Los Angeles, CA, USA, 12-13 Jan 1988).

There are two principle approaches to inertial confinement fusion (ICF): direct and indirect drive. In the indirect or hohlraum approach to fusion, pursued primarily at the national weapons laboratories at Los Alamos and Livermore, the driver-beam energy is absorbed and converted to x-rays by a radiation case made of a high-atomic-weight element, the x-rays are then used to drive the target implosion. In the alternative direct-drive approach, a short-wavelength high-intensity laser pulse directly luminates a bare, spherical target. The implosion of capsules by direct laser drive may be more efficient than indirect drive. The University of Rochester's Laboratory for Laser Energetics (LLE) is the primary focus in the United States used to investigate directly driven spherical target experiments.

39680 Space- and time-resolved diagnostics of soft x-ray emission from laser plasmas. Richardson, M.C. (Lab. For Laser Energetics, Univ. of Rochester, 250 East River Road, Rochester, NY (US)); Jaanimagi, P.A.; Chen, H.; Marioribanks, R.S.; Bradley, D.K.; Seely, J.F.; Feldman, U.; Brown, C.; Underwood, J.; Henke, B. v.v of High intensity laser-matter interactions. Campbell, E.M.; Baldis, H. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-8801117–: High intensity laser matter interactions, Los Angeles, CA, USA, 12-13 Jan 1988).

The analysis of soft x-ray emission from plasmas created by intense short-wavelength laser radiation can provide much useful information on the density, temperature and ionization distribution of the plasma. Until recently, limitations of sensitivity and the availability of suitable x-ray optical elements have restricted studies of soft x-ray emission from laser plasmas. In this paper, the authors describe novel instrumentation which provides high sensitivity in the soft x-ray spectrum with spatial and temporal resolution in the micron and picosecond ranges respectively. These systems exploit advances made in soft x-ray optic and electro-optic technology. Their application in current studies of laser fusion, x-ray lasers, and high density atomic physics are discussed.

39681 Analysis of K- and L-shell spectra emitted from implosions of argon filled and argon/krypton filled microballoons. Hooper, C.F. Jr. (Univ. of Florida, FL (US)); Mancini, R.C.; Kilerease, D.P.; Woltz, LA.; Richardson, M.C.; Bradlley, D.K.; Jaanimagi, P.A. v.v of High intensity laser-matter interactions. Campbell, E.M.; Baldis, H. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-8801117–: High intensity laser matter interactions, Los Angeles, CA, USA, 12-13 Jan 1988).

Experimental results from laser driven implosions of argon-and argon/krypton-filled polymer shell targets are presented. Analysis of the results is discussed with regard to the physics involved and the potential use of spectral features as density diagnostics.

39682 Analysis of plasma spectroscopic data at Livermore. Lee, R.W. (Lawrence Livermore National Lab., Univ. of California, Livermore, CA (US)); Cauble, R.; Back, C.; Petway, L.; Keane, C. v.v of High intensity laser-matter interactions. Campbell, E.M.; Baldis, H. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-8801117–: High intensity laser matter interactions, Los Angeles, CA, USA, 12-13 Jan 1988).

The process of analyzing plasma spectroscopic data is a difficult one involving several separate, but coupled steps. The authors briefly describe this process and its application to several experiments being conducted at Livermore, closing with two theoretical projects being developed at LLNL to aid the spectroscopist and improve the analysis.

39683 Behavior of a simple metal under ultrashort pulse high intensity laser illumination. Milchberg, H.M. (AT and T Bell Labs., Murray Hill, NJ (US)); Freeman, R.R.; Davey, S.C. v.v of High intensity laser-matter interactions. Campbell, E.M.; Baldis, H. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-8801117–: High intensity laser matter interactions, Los Angeles, CA, USA, 12-13 Jan 1988).

The authors have observed the self-reflection of intense, subpicosecond 308 nm light pulse incident on a planar Al target and have inferred the electrical conductivity of solid density Al. The pulse lengths were sufficiently short that no significant expansion of the target occurred during the measurement. They describe the experimental study of the electrical conductivity of a solid density material, in this case a simple Drude metal, over an extended range of elevated temperature with little or no change in its density. The self-reflection of a laser pulse, focused onto a smooth target at fixed pulsewidth and spot size, was monitored over four orders of magnitude in energy. The frequency shifts of the reflected light were also recorded as a function of the laser energy for a given pulsewidth.

39684 Emission of lithiumlike transitions from dense plasmas created by picosecond KrF laser pulses. Seely, J.F. (E.O. Hulburt Center for Space Research, Naval Research Lab., Washington, DC (US)); Feldman, U.; Nam, C.H.; Tighe, W.; Suckwear, S.; Woltz, L.A. v.v of High intensity laser-matter interactions. Campbell, E.M.; Baldis, H. SPIE Society of Photo-Optical Instrumentation Engineers, Bellingham, WA (1988). (CONF-8801117–: High intensity laser matter interactions, Los Angeles, CA (USA), 12-13 Jan 1988).

Broad spectral lines have been observed in the high-resolution extreme ultraviolet (XUV) spectra from plasmas created by irradiating solid targets using picosecond laser pulses. Transitions of the type n=2-3 and n=2-4 in Li-like ions of the elements N, O, F, and Al have linewidths up to 2 A. Using quasistatic ion Stark broadening, the electron densities of the plasma emission regions have been derived from the linewidths. The derived electron densities are found to be inversely proportional to the lifetimes of the upper levels of the transitions. The electron densities range from 2×10^{22} cm^{-3} for levels with lifetimes less than 4 picoseconds to 10^{21} cm^{-3} for levels with lifetimes greater than 30 picoseconds. In effect, the XUV emission is time-resolved in the expanding plasma. The observation of emission from solid-density regions (greater than 4×10^{23} cm^{-3}) requires transitions from levels in highly-charged ions with lifetimes less than a picosecond.

39685 Two-fluid theory of thermal transport in current-carrying edge plasma. Mondt, J.P. (Los Alamos National Lab., NM (USA)); Weiland, J. *Physica Scripta (Sweden),* 39(1): 92-99 (Jan 1989).

A nonlinear analysis of the current-convective instability is carried out on the basis of a classical, two-fluid model that includes the effects of parallel electron current and thermal conductivity, electron compressibility and thermal force. Restriction is made to time rates of change slow compared with the resistive diffusion rate across a perpendicular wavelength. Assuming the background gradient of electron temperature to be much greater than that of the density, a set of mode-coupling equations between electron temperature and electrostatic potential Fourier components is analysed numerically. The heat flux is computed explicitly, The influence of parallel current and electron conductivity on plasma edge transport due to thermal excitations is determined and discussed. (orig.).

39686 Line identifications and radiative-branching ratios of magnetic dipole lines in Si-like Ni, Cu, Zn, Ge, and Se. Datla, R. U. (National Institute of Standards and Technology, Gaithersburg, Maryland 20899(US)); Roberts, J. R.; Woodward, N.; Lippman, S.; Rowan, W. L. *Physical Review [Section] A: General Physics (USA),* 40(3): 1484-1487 (1 Aug 1989).

Magnetic dipole transitions within the ground-state configuration of Si-like Ni, Cu, Zn, Ge, and Se have been observed. Seven lines have been newly identified. Observations are made on the Texas Experimental Tokamak by laser-ablation injection of each of these elements into the plasma. The radiative-branching-ratio technique, utilizing lines originating from the same upper level, $3p^2\ ^1D_2$, is used for the radiometric calibration of a 1-m normal-incidence spectrometer. This calibration is in good agreement with the absolute radiometric calibration obtained by using an argon miniarc.

39687 Phase conjugation by four-wave mixing in inhomogeneous plasmas. Williams, E. A. (Lawrence Livermore National Laboratory, L472, Box 5508, Livermore, California 94550(US)); Lininger, D. M.; Goldman, M. V. *Physics of Fluids B: Plasma Physics (USA),* 1(8): 1561-1564 (Aug 1989). DOE Contract W-7405-ENG-48.

The effects of density, temperature, and velocity gradients on four-wave mixing (FWM) in a plasma are investigated. A fluid model is used in which the stimulated Brillouin terms are included, but pump depletion is neglected. The steady state phase conjugate reflectivity and signal transmission coefficients are calculated and discussed for both degenerate and resonant FWM. The substantial effects of inhomogeneity on the use of FWM as a plasma diagnostic are discussed.

39688 Drift-Alfven kinetic stability theory in the ballooning mode approximation. Hong, B. (Department of Physics and Institute for Fusion Studies, The University of Texas at Austin, Austin, Texas 78712(US)); Horton, W.; Choi, D. *Physics of Fluids B: Plasma Physics (USA),* 1(8): 1589-1599 (Aug 1989).

The coupled drift-shear Alfven mode including the complete Bessel function gyroradius effect and the $\nabla_\perp B$ -curvature guiding center drift resonance of kinetic theory is solved for the toroidal ballooning mode eigenvalues and eigenfunctions. Comparisons between nonlocal (ballooning) and local kinetic theory and between nonlocal fluid and kinetic theory are made. The critical plasma pressure for kinetic ballooning mode instability is only the same as the magnetohydrodynamic (MHD) theory critical pressure β_{MHD} for η_i=0. The critical kinetic theory plasma pressure $\beta_K(\eta_i)$ is well below β_{MHD} and the kinetic theory growth rate is unstable for all k. The MHD second stability region is also unstable in the kinetic theory. The kinetic theory growth rate is a maximum around $k\leq$0.3–0.5 for finite aspect ratio $\epsilon_n=r_n/R$. The effects of trapped electrons are found to be weakly stabilizing both analytically and numerically, and the instability is still significant outside the ideal MHD stable window from the ion magnetic drift resonances when $\eta_i\gtrsim$1. The kinetic growth rate is a function of the six dimensionless parameters k, $q^2\beta$, ϵ_n, s, η_i, and $\tau=T_e/T_i$.

39689 Cavity perturbation measurement of plasma density in complex geometry rf discharges. Moroney, R. M. (Department of Electrical Engineering and Computer Science and the Electronics Research Laboratory, University of California, Berkeley, California 94720(US)); Lichtenberg, A. J.; Lieberman, M. A. *Journal of Applied Physics (USA),* 66(4): 1618-1621 (15 Aug 1989).

A noninvasive microwave diagnostic is used to determine the plasma density in a complex geometry rf discharge chamber. Data have been obtained using several cavity modes and a wide range of pressures and powers. The measured peak densities are approximately a factor of 2 lower than those obtained from Langmuir probe measurements.

39690 A theoretical study of a laser-irradiated capillary discharge. Petway, L. B. (Lawrence Livermore National Laboratory, Livermore, California 94550(US)); Back, C. A.; Estabrook, K.; Lee, R. W.; Zigler, A. *Journal of Applied Physics (USA),* 66(4): 1632-1640 (15 Aug 1989). DOE Contract W-7405-ENG-48.

A theoretical study of a laser-irradiated capillary discharge is presented. The discharge produces a columnar flow of low-temperature plasma (1 eV) with a density of 10^{19} atoms/cm^3. This ambient low-temperature plasma is then irradiated by a 1.06-μm Nd glass laser with pulse lengths from 100 ps to 1 ns. The resultant plasma is studied, using hydrodynamic simulations coupled to a detailed kinetics model.

39691 Variational methods for studying tokamak stability in the presence of a thin resistive wall. Haney, S. W. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550(US)); Freidberg, J. P. *Physics of Fluids B: Plasma Physics (USA),* 1(8): 1637-1645 (Aug 1989).

External magnetohydrodynamic modes stabilized by the presence of a close-fitting perfectly conducting wall become destabilized when the wall is assumed to possess finite resistivity. A simple variational principle giving an estimate for the resulting growth rate and the threshold for stability is derived in terms of quantities relating to the ideal system with and without a perfectly conducting wall. This variational principle is valid for an arbitrary three-dimensional external mode in an arbitrarily shaped plasma possessing an arbitrarily shaped, but thin, resistive wall. As an example of the utility of the method, the variational principle is used to investigate the axisymmetric (n=0) stability of straight, zero pressure elliptical tokamaks with arbitrary current density profiles in the presence of a resistive wall.

39692 Bootstrap current control in stellarators. Shaing, K. C. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831(US)); Carreras, B. A.; Dominguez, N.; Lynch, V. E.; Tolliver, J. S. *Physics of Fluids B: Plasma Physics (USA),* 1(8): 1663-1670 (Aug 1989). DOE Contract AC05-84OR21400.

The poloidal coil system of a stellarator can be used to modify the |**B**| spectrum and, as a consequence, change the magnitude of the bootstrap current. The addition of a small l=1 field component to a stellarator field can cancel or reverse the direction of the bootstrap current. It is shown that currentless operation in the collisionless regime is not impaired by bootstrap current, because the effects of bootstrap current can be eliminated by an appropriate external coil system. The advanced toroidal facility (ATF) [Fusion Technol. **10**, 179 (1986)] can be used to test some of these results.

39693 The role of m=0 modal components in the reversed-field-pinch dynamo effect in the single fluid magnetohydrodynamics model. Nebel, R. A. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545(US)); Caramana, E. J.; Schnack, D. D. *Physics of Fluids B: Plasma Physics (USA),* 1(8): 1671-1674 (Aug 1989).

The role of the m=0 modal components on the reversed-field-pinch (RFP) dynamo effect is examined in the single fluid magnetohydrodynamic (MHD) model by comparing results with and without various nonlinear convolutions of the m=0 spectrum. Results indicate that the dynamo effect comes directly from the m=1 instabilities and the effect of other nonlinear convolutions is small. Scaling studies of $\delta B/B$ with the Lundquist number (S) are also performed. It is found that $\delta B/B$ is independent of S (diffusionlike scaling), which is consistent with the view that the dynamo effect arises directly from the m=1 modes.

39694 Power balance analysis of ion Bernstein wave heating experiments in the Alcator C tokamak. Moody, J. D. (Plasma Fusion Center and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139(US)); Porkolab, M. *Physics of Fluids B: Plasma Physics (USA),* 1(8): 1675-1691 (Aug 1989).

Energy and particle transport processes in Alcator C [Phys. Rev. Lett. **60**, 298, (1988)] discharges heated by directly launched ion Bernstein waves (IBW) are investigated using the onetwo transport code [Nucl. Fusion **26**, 329 (1986)]. The dependence of the observed ion heating rate ($\Delta T_H/P_H$) on plasma density is shown to result mainly from the inherent ion energy confinement that is characteristic of these discharges in the Ohmic phase and not on IBW propagation and absorption characteristics. The inferred value of the Ohmic ion thermal conduction exhibits an increasing anomaly with increasing plasma density. At a plasma density of $n_e \lesssim 1\times10^{20}$ m^{-3}, the inferred ion thermal conduction is nearly equal to the Chang–Hinton neoclassical prediction. However, at a plasma density of $n_e \gtrsim 2\times10^{20}$ m^{-3}, the inferred ion thermal conduction increases to about 5–8 times the Chang–Hinton neoclassical value. This increasing anomaly, which may result from the ion temperature gradient driven instability, can essentially account for the observed ion heating rate behavior during IBW heating. The effect of edge turbulence on IBW propagation is modeled using a Monte Carlo direct sampling simulation. The result is mainly a radial broadening of the calculated power deposition profile with increasing plasma density.

39695 Radio-frequency wave interchange stability experiments below the ion cyclotron frequency. Browning, J. J. (Department of Nuclear Engineering and Engineering Physics, University of Wisconsin, Madison, Wisconsin 53706(US)); Hershkowitz, N.; Intrator, T.; Majeski, R.; Meassick, S. *Physics of Fluids B: Plasma Physics (USA),* 1(8): 1692-1701 (Aug 1989).

It has been demonstrated in the Phaedrus-B tandem mirror [Phys. Fluids **31**, 714 (1988)] that radio-frequency (rf) waves applied below the ion cyclotron frequency ($\omega/\Omega_i \approx$0.75) can stabilize a mirror plasma against the interchange instability. Results presented here demonstrate stabilization over a range of frequencies ($0.65\leq\omega/\Omega_i\leq0.8$) with the $m_{MHD}=-1$ instability stabilized and higher-order ($|m_{MHD}|\geq2$) low-amplitude modes present. Radial profiles of the rf magnetic fields at a number of axial locations as well as parallel

wavenumber measurements indicate $m_H = -1$ slow shear Alfven wave excitation over this frequency range. Measurements at frequencies below $0.75\Omega_i$ indicate attenuation of rf waves by gas baffles and a gas box.

39696 Electron beam and magnetic field mapping techniques used to determine field errors in the ATF torsatron. Colchin, R. J. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-8072(US)); Anderson, F. S. B.; England, A. C.; Gandy, R. F.; Harris, J. H.; Henderson, M. A.; Hillis, D. L.; Kindsfather, R. R.; Lee, D. K.; Million, D. L.; and others. *Review of Scientific Instruments (USA)*, 60(8): 2680-2689 (Aug 1989). DOE Contract AC05-84OR21400.

The beam from an electron gun was used to trace flux surfaces in the Advanced Toroidal Facility (ATF) torsatron. The ATF magnetic field was run steady state at 0.1 T, and the electron beam was detected optically with an image-intensified, solid-state camera when it impinged on a phosphor-coated screen. Closed flux surfaces and islands at several low-order resonances were observed. The largest island, located at the $\iota = 1/2$ surface, was from 5 to 6 cm in width, and its presence implied the existence of magnetic field errors. To determine if these error fields could be traced to small misalignments of the magnetic coils, a device capable of accurately measuring the radial and vertical magnetic field components of individual coil sets was placed in the center of ATF. This device allowed for a determination of the precise location of each of the coils that make up the ATF coil set. No significant coil misalignments were found. A further investigation of the coil configuration led to the identification of dipole fields in the helical field coil leads as the source of the field errors. The techniques developed in making these measurements are described in the text.

39697 Getter pump for hydrogen and hydrocarbon gases. Hsu, W.L. To Dept. of Energy, Washington, DC. USA Patent 4,820,226. 11 Apr 1989. Filed date 14 Oct 1987. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

A gettering device for hydrogen isotopes and gaseous hydrocarbons based on the interaction of a plasma and graphite used as cathodic material. The plasma is maintained at a current density within the range of about 1 to about 1000 mA/cm^2. The graphite may be heated to a temperature greater than 1000^{0}C. The new device offers high capacity, low noise, and gas species selectivity.

7002 Fusion Power Plant Technology

Refer also to citation(s) 38955, 38969, 38972, 38973, 39486, 39664, 39671, 39672, 39675, 39676, 39678, 39679, 39681, 39697

39698 (CFFTP-G–86020) **Tritium systems concepts for the next European torus (NET).** Sood, S.K.; Bagli, K.S.; Busigin, A.; Kveton, O.K.; Dombra, A.H.; Miller, A.I. Canadian Fusion Fuels Technology Project, Toronto, ON (Canada). Sep 1986. 164p. Order Number DE89630549/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The study deals with the design of the various tritium processing facilities that will be required for the Next European Torus (NET) design. The reference data for the design of the NET Tritium Systems was provided by the NET team. Significant achievements of this study were: (a) Identification of new ways of handling some problems for example: (1) Recovery of tritium from the helium purge of the lithium-ceramic blanket using a novel Adsoprtion and Catalytic Exchange Process, (2) A new way of combining fuel component separation and coolant water detritiation using cryogenic distillation, (3) The use of parasitic refrigeration for the cryogenic isotope separation, (4) Tritium extraction from effluent gas streams at their respective sources, (5) Attempt to eliminate the need for Air Cleanup Systems. (b) Identification of uncertainties, for example: composition of plasma exhaust, required helium purge rate of Li-Pb for tritium recovery, uncertainty in requirements for decontaminating blanket sectors, etc. (c) Review of ways to limit tritium permeation into steam by swamping with hydrogen and to provide quantitative estimates for this permeation.

39699 (DOE/ET/51013–266) **Alcator C-Mod ICRF antenna and matching circuit.** Golovato, S.N.; Porkolab, M.; Takase, Y.; Holcomb, H.L. Massachusetts Inst. of Tech., Cambridge, MA (USA). Plasma Fusion Center. Jun 1989. 11p. Sponsored by DOE Energy Research. DOE Contract AC02-78ET51013. (PFC/CP–89-2;CONF-8905120–19: 8. American Physical Society topical conference on radio frequency power in plasmas, Irvine, CA, USA, 1-3 May 1989). Order Number DE89014858/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Alcator C-Mod will be a compact, high field, high density, divertor tokamak. Two FMIT transmitters will supply 4 MW of power in 1 sec pulses at 80 MHz for ICRF heating. Fast wave minority heating experiments are planned in D(^{3}He) at 8 T and D(H) at 5.5 T. The first antenna will have a single current strap inside a box structure, which will be movable radially. The antenna will be inserted through a side port, making the rf power density on the antenna surface ~2 kW/cm^2 at 2 MW. The antenna will be center-tapped for mechanical strength and have a double layer Faraday screen tilted along the field lines. The antenna geometry was chosen to maximize power coupling assuming voltage-limited operation. A wide antenna with slotted box sides appears the best design, and 10 Ω of loading is required to couple 2 MW of power at a voltage limit of 40 kV. Matching is achieved by choice of the drive point to a resonant circuit formed by the antenna and a loop of transmission line outside of the vacuum and by tuning elements in the transmission line to the transmitter. 6 refs., 4 figs.

39700 (EGG-M–88201) **Muon catalyzed fusion beam window mechanical strength testing and analysis.** Ware, A.G.; Zabriskie, J.M. EG and G Idaho, Inc., Idaho Falls, ID (USA). 1989. 4p. Sponsored by DOE Energy Research. DOE Contract AC07-76ID01570. (CONF-890855–29: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA, USA, 14-18 Aug 1989). Order Number DE89011135/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A thin aluminum window [0.127 mm (0.005-inch) thick x 146 mm (5 3/4-inch) diameter] of 2024-T6 alloy was modeled and analyzed using the ABAQUS non-linear finite element analysis code. A group of windows was fabricated, heat-treated and subsequently tested. Testing included both ultimate burst pressure and fatigue. Fatigue testing cycles involved "oil-canning" behavior representing vacuum purge and reversal to pressure. Test results are compared to predictions and the mode of failure is discussed. Operational requirements, based on the above analysis and correlational testing, for the actual beam windows are discussed. 1 ref., 3 figs.

39701 (EUR–11705) **Proceedings of the 2. Workshop on Wendelstein VII-X.** Rau, F.; Leotta, G.G. (eds.). Commission of the European Communities, Luxembourg (Luxembourg). 1988. 553p. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). Available from NTIS (US Sales Only), PC A24/MF A01.

The specification and final concept of W VII-X were discussed. Plasma equilibrium; plasma stability; transport; bootstrap current; plasma parameter prediction methods; boundary regions; heating; the coil system; and mechanical engineering aspects were considered. A Helias configuration with five field periods (rather than the four previously suggested) is advocated. The major radius is increased to 6.5m to alleviate plasma-wall interaction effects due to the increased number of field periods. The magnetic field is reduced from 4 to 3T, to keep the amount of superconducting material needed for coils fixed.

39702 (EUR–11705, pp. 59-68) **Stabilization of global modes by the vacuum magnetic well.** Herrnegger, F. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

A class of $\iota = 2.3$ stellarator configurations, which are characterized by an average magnetic hill or well and small or high shear, are analyzed with respect to free-boundary MHD modes where the electrically conducting wall is at infinity. The stellarator expansion procedure STEP is used. Results of two analyses are presented: $\iota = 2.3$ configurations consisting of five field periods; and n is less than or equal to 1 free boundary modes in Heliotron E like configurations.

39703 (EUR–11705, pp. 51-58) **Modelling magnetic fields diagnostic coils using a 3D free-boundary equilibrium code.** Gardner, H.J. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

A project to interpret the magnetic field diagnostics of the W VII-X stellarator is summarized. The NEMEC free-boundary equilibrium code is used to calculate 3D ideal-MHD equilibria which are consistent with the fields due to external currents. The signals of the diagnostic coils are related to the plasma equilibrium by combining the NEMEC code with a technique for calculating the magnetic field outside the plasma due to the plasma currents alone. These techniques will be used to design the diagnostic coils on the W VII-X device. Test run results are shown. The arrow plot for a beta value of 0.9 % shows the characteristic dipole-like field of the plasma currents. The signals of three flux loops as a function of beta produce curves which are quite smooth for moderate beta values.

39704 (EUR–11705, pp. 17-44) **Optimization of Helias for W VII-X.** Nuehrenberg, J. (Max-Planck-Institut fuer Plasmaphysik, Garching - Muenchen (DE)); Zille, R. Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

Basic MHD equilibrium and stability and results pertaining to W VII-X-AS and Helias stellarator are presented. The Helias MHD properties appear to meet W VII requirements. A series of configurations were constructed to investigate the stably accessible ranges of rotational transform, shear, aspect ratio, and number of periods. Four-period configurations do not satisfy stability goals. Configurations of type 5081 are thought to be the only ones which combine sufficiently good MHD, neoclassical transport, and coil feasibility properties.

39705 (EUR–11705, pp. 3-16) **Overview on W VII-X.** Wobig, H. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

Configurations for the W VII-X stellarator are reviewed. The MHD analysis of the Helias configuration with four field periods previously considered shows that the ballooning mode limit of the maximum plasma pressure increases with increasing number of field periods. Interest is focused on five-period Helias configurations with ballooning mode limits around a Beta factor of 5 %. Four configurations are discussed: HS4-12, an improved version of HS4-8; HS5-6, based on a quasi-helical equilibrium; plus two slightly different configurations designated as HS5-7 and HS5-8. It is proposed to increase the dimensions of the whole experiment to R=6.5m and to reduce the magnetic field to B=3T on the axis.

39706 (EUR–11705, pp. 45-50) **Free-boundary equilibria.** Merkel, P. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

A self-contained MHD description of the Helias class stellarators is obtained by determining appropriate external currents (coils) producing the Helias vacuum field and by the subsequent computing of the free-boundary equilibrium. Coil configurations are calculated with the NESCOIL code, the free-boundary equilibrium is studied via the NEMEC code, which combines the 3D fixed-boundary VMEC code and the NESTOR code for determining the vacuum field surrounding the plasma. Results for the 5081 Helias configuration, being considered for the W VII-X device are shown. The 5081 is a five-period device with aspect ratio 10 and a rotational transform between 0.8 and 1.0. It is MHD stable up to a beta value of 0.05.

39707 (EUR–11705, pp. 79-96) **Particle orbits in Helias configurations.** Harmeyer, E. (Max-Planck -Institut fuer Plasmaphysik, Garching-Muenchen (DE)); Kisslinger, J.; Montvai, A.; Rau, F.; Wobig, H. Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

Collisionless guiding center orbits are investigated in Helias systems with a/p = 30, where a is the minor radius, p is the ion Larmor radius. The calculations are performed in the unperturbed vacuum magnetic field of the modular coils, without electric fields. Most particles are circulating and well confined. Various orbits of trapped particles are seen. Deeply trapped particles are lost after typically 100 oscillations, while those with reflection points close to the local Bmax stay in the system for times up to 15ms. Pitch angle scattering or a radial electric field can reduce these losses. The HS5R4, HS5KD, and HS4V configurations are compared. It is concluded that due to the effect of drift optimization of the Helias topology, circulating alpha or high energy particles are well confined.

39708 (EUR–11705, pp. 97-120) **Monte carlo simulation of neoclassical transport in Helias.** Lotz, W. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

Neoclassical transport coefficients were computed by Monte Carlo simulation over a wide range of mean free paths, ratios of plasma to gyro radius, and electric fields. Results for monoenergetic particles can be represented by simple formulas using a transport coefficient normalized to the tokamak plateau value and a mean free path normalized to half the connection length. Transport coefficients obtained with monoenergetic particles (using pitch angle scattering and energy relaxation) were convoluted with a Maxwellian distribution. Results are compared with theory and with simulations using a Maxwellian particle distribution together with pitch angle scattering plus energy scattering. Agreement is good. Transport coefficients with Maxwellian particle distributions for various stellarator configurations are shown. Particle transport and energy transport coefficients for these configurations were computed for ions (deuterons) and electrons. From these, confinement times were derived.

39709 (EUR–11705, pp. 145-156) **Some remarks on plasma equilibrium in stellarator configurations.** Wobig, H. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

It is argued that the problem of finding a self-consistent equilibrium in nonaxisymmetric stellarator configurations can be reduced to the existence of a fixed point of a nonlinear map in a Banach space of magnetic fields. The properties of this map depend on the plasma model which determines the pressure plasma flow velocity, and the plasma currents for a given magnetic field. Any plasma model with frictional or viscous damping leads to classical elliptic problems. These damping terms remove the singularities of the ideal MHD model. However, inertial forces and compressibility of the plasma can give rise to multiple solutions and enhanced plasma losses. Islands and stochasticity occur in nonaxisymmetric configurations, and make modifications of the ideal MHD model necessary. The mathematical theory of stellarator equilibria remains incomplete, but since after retaining inertia and viscosity, the major task is to solve hydrodynamic equations, it is argued that the theory of stellarator equilibria can be established on the basis of the theory of hydrodynamic flow.

39710 (EUR–11705, pp. 121-144) **Analytic solution of the bounce averaged Fokker-Planck equation for the W VII-X.** Beidler, C.D. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

A power series solution of the bounce-averaged kinetic equation which is valid in all low collision frequency regimes is used to estimate the expected helical ripple transport in Wendelstein VII-X candidates. These analytic estimates are shown to be in good agreement with numerical results from a guiding center Monte Carlo simulation. It is also shown that Wendelstein VII-X candidates belong to the class of so-called transport-optimized stellarators, thereby having their ripple transport rates reduced by more than an order of magnitude relative to the equivalent classical stellarator which has the same aspect ratio and same average depth of helical ripple.

39711 (EUR–11705, pp. 191-202) **Transport calculations and plasma parameters.** Junker, J. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

One-dimensional transport calculations are used to show that a beta value of 5 % can be achieved in W VII-X with a heating power of 20 MW. The central electron and ion temperature is 5 keV. Establishing all the heating power by neutral injection, which leads to a particle source of 3.6×10^{21} particles/sec is only allowed if the recycling coefficient of the wall is as low as 0.2 and if the particle diffusion coefficient, which is assumed anomalous at the wall, is only 2/3 of the electron heat conduction coefficient. Replacing half of the heating power by other systems which do not deliver particles to the plasma, a recycling coefficient of 0.4 is allowed together with a diffusion coefficient which is 1/10 of the electron heat conduction coefficient. At 30 MW, achievable beta rises to 5.8 % and a recycling coefficient of 0.4 can be allowed for the same particle source.

39712 (EUR–11705, pp. 165-176) **Bootstrap current in stellarators.** Wobig, H. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

In stellarators neoclassical bootstrap currents are serious obstacles for achieving optimum confinement since the profile of the rotational transform is modified during the rise phase of the discharge. Following the theory of axisymmetric configurations like tokamaks, predictions for nearly axisymmetric stellarators like Wendelstein VII-A yield a bootstrap current of several kilo -Amps. In Wendelstein VII-AS application of the same equations yields currents up to 70 kA, depending on the achievable β. However, this estimate does not take into account the three-dimensional geometry of the magnetic surfaces and the optimization of drift orbits in Wendelstein VII-AS. In general stellarator geometry the magnitude of the bootstrap current depends on the localization of trapped particles and the kinetic equation has to be solved in order to compute the parallel viscosity which drives the bootstrap current. It can be shown that in configurations with symmetry (axisymmetry, helical symmetry, quasi-helical symmetry) bootstrap current and radial particle loss are proportional to each other. This general relation, which is already known for tokamaks can be derived without solving the kinetic equation. If the symmetry of the configuration is destroyed, it is possible to minimize the bootstrap current by a suitable choice of the magnetic field geometry. The parallel and the perpendicular viscosities have to be calculated for the various regimes of collisionality starting from the kinetic equation. In a collision dominated plasma these effects are small. The viscous tensor of a collisional plasma given by Braginskii allows to calculate these average viscous forces for an arbitrary stellarator geometry and a geometrical factor C_b can be defined which characterizes the dependence of the bootstrap current on the topology of the magnetic surface.

39713 (EUR–11705, pp. 183-190) **Transport coefficients and scaling laws.** Wobig, H. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

Scaling laws are used to show that neoclassical confinement with an effective ripple of 1% to 2% is sufficient to reach the aims of the W VII-X experiment. The more pessimistic LHS scaling predicts parameters which are too low. This underlines the importance of carefully analyzing transport properties in stellarator experiments, and of establishing reliable scaling laws of confinement.

39714 (EUR–11705, pp. 203-214) **Some aspects of ECRH for the W VII-X.** Erckmann, V. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

The plasma parameters for various ECRH scenarios are estimated by a simple steady state transport model. Power scans at B = 2.5T (2nd harmonic X-mode), B = 4.0T and B = 5.0T (1st harmonic, 0 mode) were performed at peak densities of $1 \times 10^{20} m^{-3}$, which is compatible with the cut-off density restrictions. At an absorbed power of 5MW temperatures of Te = 6 keV, Ti = 5 keV are obtained for Bo = 5T. The corresponding figures for Bo = 2.5T are 3.5 and 3 keV. The energy replacement time is 0.5 and 0.2 sec, respectively. Beta values are 0.6% (5T) and 1.4% (2.5T). The applicability of 2nd harmonic 0 mode heating would provide the same cut-off density as 1st harmonic mode at 5T, but significant absorption is seen for this mode only for Te over 5 keV.

39715 (EUR–11705, pp. 221-230) **ICRH for W VII-X.** Wesner, F. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

The theoretical and technological feasibility of using ICRH for W VII-X are assessed. For a sufficiently hot target plasma, ICRH looks attractive. For H - minority heating, a very small minority percentage should be used (under 5%); He3-minority heating should not be excluded. For 2 Ohm CH, at low temperature, conversion to IBW is essential; at high temperature, good first transit absorption by H ions is indicated. The wave boundary interaction with the wall could play a large role. The influence of toroidal symmetry cannot be predicted. For 1.5 MW radiated power per port (35 x80 cm ports) average power density = 500 W/cm^2, and 65% of launched power should be absorbed.

39716 (EUR–11705, pp. 231-244) **Coil systems for Helias.** Merkel, P. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

An extended version of the NESCOIL code was applied to candidate Helias configurations for W VII-X. The code determines current filaments on an outer bounding surface which produce an approximation to the ideal vacuum field. The outer boundary is varied systematically to satisfy additional practical constraints. The method is demonstrated by showing a coil configuration for W VII-AS. A torsatron-like coil configuration for the Kyoto Helias is presented.

Coils for Helias configurations with different period numbers and aspect ratios are presented. An attempt to realize a coil system where each coil is represented by two filaments such that the set of the outer filaments produce the field of the shearless 5099 Helias configuration is shown.

39717 (EUR–11705, pp. 245-262) **Coil development for W VII-X.** Kisslinger, J. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

Starting from a closed vacuum flux surface near the edge and using the NESCOIL code, current distributions on various toroidal surfaces are obtained. The toroidal surfaces are optimized by varying the coefficients which describe the torus topology, and by restricting the number of coefficients for the potential distribution. Configuration HS4-12 with 4 field periods has 12 coils per field period, and that with 5 periods has 10 or 12 coils per period at an average coil aspect ratio of 5. Aspect ratio of the largest flux surfaces is 10. For Helias configurations with 5 field periods compared to those with 4 field periods, higher beta values are predicted. Keeping the coil aspect ratio constant the configuration with 5 field periods has coils with lower minimum curvature radius and a larger lateral excursion. They also have reduced distance between wall and plasma. To improve the geometrical tightness with 5 field periods an increase of the major radius from 5 to 6.5m and a reduction of Bo from 4 to 3T (which allows an increase of current density from 40 to 50 MA/m^2) is proposed.

39718 (EUR–11705, pp. 263-296) **Parameter variation in the HS4V11 and HS4V12 (t and B_z).** Harmeyer, E. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)); Kisslinger, J.; Montvai, A.; Rau, F.; Wobig, H. Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

Results on the parameter range for the modular Helias systems HS4V11 and HS4V12 with M = 4 field periods are given, regarding external variations in the unperturbed magnetic fields. No preference for the sign of the shear can be derived for the definition of a reference configuration for W VII-X. Double layer coils are preferred because of the more compact system size for both superconducting or pulsed water-cooled coils in the modular system-for the pulsed vertical field coil system, an option with independent coils is advocated because of its ability to also control error fields. For quadrupole fields, superposed to the case where alpha rotational transform = 4/5, very large coil currents in the inner coils are required. This causes coil volumes to increase to intolerable values at acceptable values of the dissipated energy, but no marked effects are seen in the vacuum fields.

39719 (EUR–11705, pp. 297-320) **Forces and stresses in Helias coil systems.** Harmeyer, E. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

Forces and stresses inside Helias coil configurations and the associated structure were analyzed. Because of the larger toroidal excursion of the HS5-8 coils compared with HS4-12, the lateral force densities are increased for HS5 -8. The helical contour of the magnetic axis causes a related helicity in the net coil force vector, corresponding to different coil forces in the radial and vertical directions. For mechanical stabilization the coils need a reinforcement by structural material of stainless steel. Stress and strain computations for HS4-12 show that the coils are feasible. Because of the stiff support structure, the maximum stress values inside the coils do not vary much if one of the individual coils is not energized. If coil housing is partly removed to allow access to the inner side of the coils, stress values are increased by a factor of up to 1.8.

39720 (EUR–11705, pp. 215-220) **Neutral injection into W VII-X.** Speth, E. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)); Penningsfeld, F.P. Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE (USA), 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

The parameters for W VII X Neutral Injection, that are being envisaged at present, are based on the assumption, that ASDEX-Upgrade type injectors could be used on W VII X. The ASDEX-Upgrade injection will typically deliver 6 MW hydrogen or 9 MW deuterium per box, N means the number of boxes required. The quoted neutral current of 10^{21} S^{-1} per box is an approximate figure and depends in detail on the assumption about the species composition and the beam energy.

39721 (EUR–11705, pp. 373-388) **On normal conducting W VII-X coil systems.** Harmeyer, E. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

The normal-conducting coil system for W VII-X was investigated regarding electric power needed, total dissipated energy, and the temperature rise inside the coils. The lowest values are obtained by minimizing the current density in the coils and the magnetic field on axis. The lowest attainable values are Pmax = 270 MV A and Wtot = 2550 MJ for a major radius Ro = 7m, stored magnetic energy Emag = 600 MJ, magnetic field on axis Bo = 2.4T, and current density in the coils jc = 10.4 MA/m^2. For Ro = 5m, Emag = 600 MJ, Bo = 4T, and jc = 24 MA/m^2, while Pmax = 440 MV A, and Wtot = 4400 MJ. Temperature rise is moderate, between 10 and 47K.

39722 (EUR–11705, pp. 389-404) **Mapping of the W VII-AS magnetic field.** Jeanicke, R. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

Results of the experimental mapping of the magnetic surfaces in W VII-AS are given. The radial dependence of the rotational transform is found to within 1.5 % for the standard case of the configuration. In the investigation of the irrational rotational transform, the shape and position of the surfaces, the magnitude of the rotational transform, and the size of the last observed surface seem to be well described by the numerial predictions. In the rational transform, islands in the ideal vacuum fields also show good agreement with predictions, except 5/m. Additional islands in the real vacuum fields exist and are seen only at major resonances.

39723 (EUR–11705, pp. 335-366) **General aspects of magnet design for W VII-X.** Maurer, W. (Kernforschungszentrum Karlsruhe, G.m.b.H. (DE). Inst. fuer Technische (KFK)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

The general aspects of the superconducting magnet design for the stellarator W VII-X are summarized. This overview includes the requirements of physics as e.g. the magnitude of the magnetic field, the ripple, and special field shapes at some locations. Conductor related requirements are manifold: choice of operational current at the designed magnetic field strength and operating temperature, amount of stabilization materials taking into account the magnetoresistance and the mechanical strength, choice of cooling mode (pool boiled, forced flow, He II), allowable strain and AC losses. These

aspects are discussed in view of the conductor design of W VII-X. Also dimensional and structural requirements are shortly discussed for a modular stellarator. Other aspects are discussed in view of the conductor design of W VII-X. Also dimensional and structural requirements are shortly discussed for a modular stellarator. Other aspects are the costs of the magnet system and the safe operation. These general requirements are then specified for a four periodical Helias with a total of 48 superconducting magnets with a mean radius of about 1m.

39724 (EUR–11705, pp. 367-372) **Design problems of a cryostat for W VII-X.** Kisslinger, J. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

The problems in the W VII-X cryostat in minimizing the radial distance from the winding pack to the wall facing the plasma in order to provide sufficient space between the plasma and the wall are described. Another problem occurs because of air pressure loads on the vacuum vessels. Large mechanical stresses result from the thin wall of the inner pressure vessel and its imposed shape. Thermal strains induce further mechanical stresses, and bellows may have to be used to reduce them. The thermal load from the plasma to the inner vessel also causes local thermal strains, so water cooled panels inside the vessel must absorb the heating energy.

39725 (EUR–11705, pp. 321-334) **Computer techniques for development and quality assurance.** Simon-Weidner, J. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE (USA), 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

Numerical techniques and the associated computer aided design methods used for quality assurance of geometrically complicated structures such as stellarator coils are reviewed. Finite element methods, and difference schemes are mentioned. Interactive processing, and coupling between design and computation are discussed.

39726 (EUR–11705, pp. 405-420) **Perturbation fields in W VII-AS and Helias configurations.** Harmeyer, E. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)); Kisslinger, J.; Montvai, A.; Rau, F.; Wobig, H. Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

Effects of pertubed topologies of the W VII-AS vacuum fields on the configuration with rational and irrational rotational transform are illustrated. Even small perturbation fields are unacceptable at rational values of the rotational transform. For example at a rotational transform = 1/2 in W VII-AS, when exceeding an effective homogeneous Bx/B = 3 x 10^{-4}, the size of the rotational transform = 1/2 = 5/10 islands is doubled. At irrational values a Bx/B = 1/2% shows tolerable effects, for both W VII-AS and HS4-12. At rational values of the rotational transform = 1 near the edge, Bx/B values = 1/4 to 1/8% show a rather large increase of the aspect ratio, so an edge value of rotational transform = 1 should be avoided.

39727 (EUR–11705, pp. 421-430) **Accuracy of W VII-AS coils.** Sapper, J. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

The final accuracy of the W VII-AS coil set is given by the following manufacturing steps: (1) Master coil generated by the assembly of the four plane evolutions of the coil sides. Deviation of the actual coil contours from the theoretical data set. Test and comparison in a 3D-measuring machine. (2) Winding mould with resin cast front end surfaces. Comparison between mould and master coil. (3) Impregnated and cured coil. Comparison with master coil and theoretical data set in a 3D-measuring machine. (4) Signing of the coil axis with best fit coordinates on the coil surfaces. (5) Adjustment of the coils in the structure shell, relative to the 'symmetry' plane (phi =0). (6) Assembly of the structure shell halfs to modules. (7) Assembly and adjustment of the modules onto the support structure.

39728 (EUR–11705, pp. 451-468) **On the edge structure in the vacuum field of the HS4V12.** Harmeyer, E. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)); Kisslinger, J.; Montvai, A.; Rau, F.; Wobig, H. Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

The edge structure in the vacuum field of HS4-12 is treated for the standard case of the system. The edge structure is mapped by field line integration. The results show that the edge structure of the vacuum field is influenced by the chosen value of the rotational transform. Hot spots are seen, but the statistics must be improved. Effects caused by the applied field line tracing are of minor importance, but orbits of reflected particles, electric field effects, and the influence of finite beta plasmas and of the bootstrap current pose problems.

39729 (EUR–11705, pp. 469-478) **Neutral transport calculations for W VII-X. First applications to W VII-X.** Sardei, F. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

Results of neutral gas transport calculations obtained with the DEGAS code are presented for a W VII-AS model plasma and a source of neutrals due to limiter recycling. For typical profiles of the plasma parameters as predicted for an ECRH discharge, the simulation yields a radial drop of the average neutral population by a factor of 30. The neutrals are strongly localized near the limiter and have a poloidal minimum at its opposite side. For a W VII-X configuration (HS4-12), a neutral source given by a high recycling ion flux equally distributed over the wall is considered. For an ion density of 5 x 10^{13}/cc and 30 eV edge temperature, the neutrals originating from the wall completely ionize within the ergodic region. The corresponding average energy of cx neutrals hitting the wall is less than 30 eV. Neutral penetration into the plasma locally depends on the distance between wall and separatrix.

39730 (EUR–11705, pp. 479-500) **Edge physics in Asdex-Upgrade and projections to W VII-X.** Neuhauser, J. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

Edge physics in tokamaks, the Asdex Upgrade and W VII-X were compared. Comparison of tokamaks and W VII-X show that the basic scrape-off layer structure and dominant processes are similar. The W VII-X could have simple limiter solutions without major problems. More complex structures are very difficult and sensitive to small variations of the magnetic configuration. Chances for localized target recycling/plasma plugging strongly depend on configuration. Ergodicity is probably not helpful. In contrast to approximately axisymmetric or helical systems (tokamak, torsatrons) much more elaborate methods for edge optimization are necessary. Optimization of the complete edge and impurity control system is as important as for bulk properties.

39731 (EUR–11705, pp. 501-510) **Comments on neutral beam fuelling and recycling.** Speth, E. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)); Penningsfeld, F.P. Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

Injected neutral flux versus full beam energy and species distribution is calculated using experimental cross sections. A tradeoff between beam energy and recycling in stationary state is shown. Allowable beam current versus recycling is considered. It is concluded that for W VII-X that it is of utmost importance to foresee means of density control in order to reduce the effective recycling coefficient below 1.

39732 (EUR–11705, pp. 529-536) **W VII-X, first estimates of technical feasibility and schedule.** Sapper, J. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

Project planning and feasibility aspects of W VII-X are considered. A 5m machine with 7.5T on the axis and 5s pulse time has excessive electromagnetic forces. For a 5m machine with 4T on the axis, 10s pulse time, and reduced coil cross sections of 75% with reference to full scaled values, the electromagnetic forces are much larger than those of W VII-AS. If superconduction is used, the superconducting cable itself and the cryostat enveloping the coil set have to be designed. A further complication is the heat removal system inside the torus, especially if long pulse external heating with high power is applied.

39733 (EUR–11705, pp. 511-528) **Experimental programme of W VII-AS and projections to W VII-X.** Renner, H. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

The 'advanced stellarator' WENDELSTEIN W 7AS, which is being realized according to an optimization of the magnetic configuration for equilibrium and transport, will become operational summer 1988. First results of magnetic field mapping at a magnetic field B~0.2T are already available: the existence of unperturbed magnetic surfaces confirms the potential of the engineering of modular coil systems with low field errors and within the necessary accuracy. Measurements of the rotational transform, the location of the magnetic axis and the magnetic separatrix at the boundary are seen in good aggreement with the designed values and, therefore, demonstrate the quality of the used methods for calculations and fabrication of the coil system. The experimental programme of W 7 AS is concentrated on investigations of 'currentless' plasmas. Three different heating systems will be used. The control of the magnetic configuration with finite plasma pressure for optimal confinement far from 'resonances' associated to rational numbers of the rotational transform needs careful processing of the plasma parameters and corrections of the profiles of the rotational transform. The flexibility of the external rotational transform, the variation of shear by modifications of the current density distribution at the plasma (bootstrap current) and superimposed vertical fields are necessary to establish optimal confinement. Confinement studies and the analysis of local transport for energy, particles and impurities will cover an extended parameter range: $n > 10^{20}$ m^{-3}, $T_{e,i} > 1$ KeV.

39734 (EUR–11705, pp. 537-546) **Summary of the workshop.** Wobig, H. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, Schloss-Ringberg, DE, USA, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89791947/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

The specification and final concept of W VII-X were discussed. Plasma equilibrium; plasma stability; transport; bootstrap current; plasma parameter prediction methods; boundary regions; heating; the coil system; and mechanical engineering aspects were considered. A Helias configuration with five field periods (rather than the four previously suggested) is advocated. The major radius is increased to 6.5m to alleviate plasma-wall interaction effects due to the increased number of field periods. The magnetic field is reduced from 4 to 3T, to keep the amount of superconducting material needed for coils fixed.

39735 (GA-A–19623) **Thermal-hydraulic design of a solid particulate fusion reactor blanket.** Wong, C.P.C.; Hasan, M.Z. General Atomics, San Diego, CA (USA). Apr 1989. 6p. Sponsored by DOE Energy Research. DOE Contract AC03-89ER52153. (CONF-890855–23: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA, USA, 14-18 Aug 1989). Order Number DE89010866/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper presents the scoping thermal-hydraulics design of the Advanced Reactor Innovation Evaluation Study (ARIES-I) fusion reactor blanket that is cooled by a mixture of SiC fine particles and CO_2 carrier gas. When compared to a conventional gas-cooled design, the primary advantage of this design is to greatly improve the volumetric heat capacity of the coolant, allowing lower flow velocity, pressure drops and reduced coolant pressure while maintaining the same heat transfer capability. Thermal-hydraulics parametric results and the SiC ceramic composite structured 5 atm pressure CO_2 gas reference design are presented in this paper. 11 refs., 4 figs., 2 tabs.

39736 (INIS-mf–11480, pp. 23-24) **Source energy spectra of reaction products from exothermal fusion reactions.** Heinrichs, G.; Riedler, H.; Schoepf, K. Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik. Nov 1988. (In German). In *Annual report of the Institute for Theoretical Physics in Graz, Austria.* Order Number DE89631627/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

DEUTERIUM TARGET/deuteron reactions; THERMONUCLEAR REACTIONS/energy spectra; NEUTRONS; PROGRESS REPORT; PROTONS

39737 (JAERI-M–88-230) **Nuclear and activation characteristics of materials in 14.1-MeV and 2.5-MeV neutron field.** Seki, Yasushi; Takeyasu, Yuuichi. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1988. 102p. Order Number DE89790754/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The nuclear and activation characteristics of various materials and elements of interest in terms of fusion reactor design are calculated and the results are graphically shown. The elements and materials are placed in a simple geometry modelling a blanket and shield of a fusion reactor. The neutrons with 14.1-MeV and 2.5-MeV energy are generated from the region represented as D-T and D-D plasma, respectively. The following activation characteristics after neutron irradiation are shown for each material and element; 1. Time evolution of induced activity, 2. Time evolution of decay heat, 3. Delayed gamma-ray dose distribution, 4. Decay heat distribution. In addition to the above activation characteristics, nuclear characteristics during the neutron irradiation, e.g. neutron energy spectra, neutron and gamma-ray flux distribution, nuclear heating distributions, and neutron and gamma-ray dose rate are also shown.

39738 (JAERI-M–88-247) **Studies on first wall and plasma wall interaction in JT-60.** Nakamura, Hiroo. Japan Atomic Energy Research Inst., Tokyo (Japan). Dec 1988. 233p. (In Japanese). Order Number DE89790753/JAW. Available from NTIS (US Sales Only), PC A11/MF A01.

This paper describes studies on first wall and plasma wall interaction in JT-60. Main results are as follows; (1) To select JT-60 first wall material, various RandD were done in FY1975 ~ 1976. Mo was selected as first wall materials of limiters and divertor plates because of its reliability under a high heat flux condition. (2) Development of low-Z material has been done to reduce impurity problem

of Mo first wall. As a result, titanium carbide (TiC) was selected as a coating material on the Mo. High heat load testing has been done for TiC coated Mo limiter same as JT-60. This material can survive under the condition of 1 kW/cm^2 x 10 s, expected in JT-60 limiter design. (3) To reduce high heat load on the divertor plate, separatrix swing is proposed. Optimum frequency of the sweeping is evaluated to be 2 Hz in JT-60. For a discharge with heating power of 30 MW and duration time of 10 s, in addition to the separatrix swing, remote radiative cooling in the divertor region is necessary. Moreover, calculations of erosion thickness have been done for stainless steel, Mo, graphite, TiC and silicon caibide under high heat flux during plasma disruption. (4) In divertor experiments in JT-60, divertor functions on particle, heat load and impurity controls have been demonstrated. In elctron density of 6 x 10^{19} m^{-3}, particle fueling rate of 20 MW NB heating (3 Pa m^3/s) can be exhausted by divertor pumping system. Effectiveness of remote radiative cooling is demonstrated under the condition of 20 MW NB heating power. Also, separatrix swing is demonstrated to reduce heat load on the divertor plate. Total radiation in main plasma is 5 ~ 10% of total absorbed power. (author) 120 refs.

39739 (KEK–88-7, pp. 98-105) **Large diameter ion source and its application to industry.** Sato, Tadashi (Hitachi Ltd., Ibaraki (Japan). Hitachi Research Lab.). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Oct 1988. (CONF-8804288–: Symposium on negative ion sources and their applications, Tsukuba, Japan, 5-6 Apr 1988). In *Proceedings of the symposium on negative ion sources and their applications.* Order Number DE89012159/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

A bucket-type ion source developed for nuclear fusion experiments is applied to microfabrication of magnetic thin film heads and metal surface treatment. An ion milling apparatus having a bucket source whose beam extracting electrode diameter is 58cm was developed for the microfabrication of magnetic thin film heads. Twenty four 3" wafers in the apparatus are possible to be bombarded at the same time. Surface treatment by ion implantation has the problem of shallow penetration depth of the order of 0.1μm of the implanted ions. To overcome this problem, a high current bucket source was combined with a simultaneous deposition method (dynamic mixing). TiN film of 15μm thickness was made by this method.

39740 (KEK–88-7, pp. 147-157) **Development of DC power supplies for high power ion sources.** Watanabe, K. (Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Oct 1988. (CONF-8804288–: Symposium on negative ion sources and their applications, Tsukuba, Japan, 5-6 Apr 1988). In *Proceedings of the symposium on negative ion sources and their applications.* Order Number DE89012159/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

Protection of ion sources from electrical breakdowns will be one of the most important subjects for a power supply of the next generation neutral beam injector (NBI). We discuss how to protect ion sources from electrical breakdowns and the design concept of a high power DC power supply. We proposed a high speed AC switch instead of a conventional DC switch and surge reduction systems to suppress the surge current and input energy to ion sources less than 1 kA and several joule.

39741 (LA-UR–89-1984) **High power opening switches for flux compression generator applications: An overview.** Reinovsky, R.E.; Goforth, J.H.; Lindemuth, I.R.; Oona, H. Los Alamos National Lab., NM (USA). 1989. 22p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890796–2: International workshop on high power opening switches, Novosibirsk, USSR, 1-2 Jul 1989). Order Number DE89014253/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The high performance explosively powered flux compression generator (FCG) represents a proven source of very large electrical energies, at very high currents, low impedances, and modest powers that is suitable for powering a variety of plasma and beam experiments. Flux compressors have the advantage of delivering energy at low and high current and are ideal for energizing inductive energy storages. They are straightforward, compact, and inexpensive, when evaluated on the basis of cost per joule for a limited number of experiments. Conventional flux compressors have the disadvantage of delivering these enormous energies on relatively long timescales thus making some form of power conditioning essential for powering many interesting loads. Since flux compressors are ideally suited to energizing inductive loads, power conditioning systems based upon inductive store/opening switch techniques are complementary to FCG energy sources. For some experiments, straightforward application of one of a variety of high-current interrupters can provide the needed power conditioning. For more demanding experiments, multi-stage combination of switches may be required. And for loads requiring voltages in excess of a few hundred kilovolts, opening switches coupled with energy storage transformers are suitable. In this paper, we will review switch concepts that have been used in conjunction with flux compressors which deliver energies in the range of 1–20 MJ. These concepts include conventional electrically-exploded fuses, explosively-formed fuses, plasma-dynamic switches, and combinations of these elements. 6 refs., 12 figs.

39742 (LA-UR–89-2127) **The high-density Z-pinch as a pulsed fusion neutron source for fusion nuclear technology and materials testing.** Krakowski, R.A.; Sethian, J.D.; Hagenson, R.L. Los Alamos National Lab., NM (USA). 1989. 42p. Sponsored by DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-8902118–1: International Energy Agency workshop on fusion materials irradiation facilities, San Diego, CA, USA, 14-17 Feb 1989). Order Number DE89014223/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The dense Z-pinch (DZP) is one of the earliest and simplest plasma heating and confinement schemes. Recent experimental advances based on plasma initiation from hair-like (10s μm in radius) solid hydrogen filaments have so far not encountered the usually devastating MHD instabilities that plagued early DZP experiments. These encouraging results along with debt of a number of proof-of principle, high-current (1–2 MA in 10–100 ns) experiments have prompted consideration of the DZP as a pulsed source of DT fusion neutrons of sufficient strength ($\dot{S}_N \geq 10^{19}$ n/s) to provide uncollided neutron fluxes in excess of I_ω = 5–10 MW/m^2 over test volumes of 10–30 litre or greater. While this neutron source would be pulsed (100s ns pulse widths, 10–100 Hz pulse rate), giving flux time compressions in the range 10^5–10^6, its simplicity, near-time feasibility, low cost, high-Q operation, and relevance to fusion systems that may provide a pulsed commercial end-product (e.g., inertial confinement or the DZP itself) together create the impetus for preliminary considerations as a neutron source for fusion nuclear technology and materials testings. The results of a preliminary parametric systems study (focusing primarily on physics issues), conceptual design, and cost versus performance analyses are presented. The DZP promises an expensive and efficient means to provide pulsed DT neutrons at an average rate in excess of 10^{19} n/s, with neutron currents $I_\omega \lesssim 10$ MW/m^2 over volumes $V_{exp} \geq 30$ litre using single-pulse technologies that differ little from those being used in present-day experiments. 34 refs., 17 figs., 6 tabs.

39743 (UCID–21705) **IFEL options for 40-MW, 280-GHz output.** Stone, R. Lawrence Livermore National Lab., CA (USA). 12 May 1989. 19p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89014405/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

During FY88, we completed the conceptual design of an induction-linac based free-electron laser (IFEL) that would provide 10 MW of average power at 280 GHz for electron cyclotron heating (ECH) on the Compact Ignition Tokamak (CIT). The proposed configuration, uses a 13-MeV, 3-kA electron beam with a 70-ns flat-top pulse operating at a pulse repetition frequency (PRE) of 10 kHz. A quasi-optical system of mirrors transports microwave power from a 0.1-m-period, 3-m wiggler to the CIT machine. A turnable backward wave oscillator (BWO) provides the seed 280-GHz wave. We estimated the cost of the installed IFEL to be about $41 million, or $4.10 per watt. In FY89, the Princeton Plasma Physics Laboratory asked us to size and cost options for increasing the average power from 10 MW to 40 MW in 10-MW increments. This report addresses several options we have identified for achieving this goal. The options considered are using additional 13-MeV accelerator at 20 kHz;

increasing the energy of the 10-kHz electron beam to 15 MeV; and increasing the energy of the electron beam to 20 MeV with and without multiplexing additional PPUs. Four 13-MeV, 10-kHz IFELs; two 13-MeV, 20-kHz machines; three 15-MeV, 10-kHz machines; and two 20-MeV, 10-kHz configurations are required to obtain 40 MW of average power. For each case, we will discuss required IFEL system changes, the cost difference relative to the baseline case, and configuration risks. 6 refs., 5 figs., 7 tabs.

39744 (UCID–21734) **On the use of the FEL to produce high transient space-charge potentials in a magnetized plasma.** Post, R.F. Lawrence Livermore National Lab., CA (USA). 26 Jun 1989. 13p. Sponsored by DOE Energy Research. DOE Contract W-7405-ENG-48. Order Number DE89014325/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A recently developed approximate theory is used to estimate the magnitude of the space-charge potentials and electric fields that could be produced within a plasma column exposed to the focussed microwave beam from the Livermore free-electron laser. The plasma, composed of electrons and singly charged high mass ions, is assumed immersed in a solenoidal magnetic field with a strong longitudinal gradient. Cyclotron resonance of the electrons in the magnetic field leads to rapid heating and an associated strong axial expelling force resulting from the interaction of the electrons' magnetic moment with the magnetic field gradient. Ion inertia, together with the quasineutrality constraint, leads to the development of a flat-bottomed potential well, thereby forcing the electron loss rate to equal the inertia-dominated rate of the ions. This phenomenon, first observed experimentally in the 1960's, is present FEL power levels (2 GW) positive potentials of 4 MV and associated sheath electric fields approaching 1 GV/meter are predicted, with column-averaged fields of order 50 MV/meter. At projected FEL power levels potentials of order 15 MV, and sheath fields of 1.6 GV/meter are predicted. These figures are much higher than the corresponding figures for conventional rf or induction-type ion accelerators. Plasma parameters appropriate for a proof-of-principle experiment are given. 4 refs.

39745 (UCLA/PPG–1171, pp. 17, Paper 1) **Deuterium pumping and erosion behavior of selected graphite materials under high flux plasma bombardment in PISCES.** Hirooka, Y.; Conn, R.W.; Goebel, D.M.; LaBombard, B.; Lehmer, R.; Leung, W.K.; Nygren, R.E.; Ra, Y. California Univ., Los Angeles, CA (USA). Plasma Physics Group. Aug 1988. In *PISCES and ALT-II: Juelich PSI papers.* Order Number DE88017301/JAW. Available from NTIS, PC A06/MF A01.

Deuterium plasma recycling and chemical erosion behavior of selected graphite materials have been investigated using the PISCES-A facility. These materials include: Pyro-graphite; 2D-graphite weave; 4D-graphite weave; and POCO-graphite. Deuterium plasma bombardment conditions are: fluxes around 7 x 10^{17} ions $s^{-1}cm^{-2}$; exposure time in the range from 10 to 100 s; bombarding energy of 300 eV; and graphite temperatures between 20 and 120°C. To reduce deuterium plasma recycling, several approaches have been investigated. Erosion due to high-fluence helium plasma conditioning significantly increases the surface porosity of POCO-graphite and 4D-graphite weave whereas little changes for 2D-graphite weave and Pyro-graphite. The increased pore openings and refreshed in-pore surface sites are found to reduce the deuterium plasma recycling and chemical erosion rates at transient stages. The steady state recycling rates for these graphite materials can be also correlated to the surface porosity. Surface topographical modification by machined-grooves noticeably reduces the steady state deuterium recycling rate and the impurity emission from the surface. These surface topography effects are attributed to codeposition of reemitted deuterium, chemically sputtered hydrocarbon and physically sputtered carbon under deuterium plasma bombardment. The co-deposited film is found to have a characteristic surface morphology with dendritic microstructures.

39746 (UCLA/PPG–1171, pp. 13, Paper 4) **Boundary asymmetries and plasma flow to the ALT-II toroidal belt pump limiter.** Corbett, W.J.; Goebel, D.M.; Conn, R.W.; McGrath, R.T.; Dippel, K.H.; Finken, K.H. California Univ., Los Angeles, CA (USA). Plasma Physics Group. Aug 1988. In *PISCES and ALT-II: Juelich PSI papers.* Order Number DE88017301/JAW. Available from NTIS, PC A06/MF A01.

The ALT-II toroidal belt pump limiter consists of 8 radially adjustable limiter blade segments located 45° below the outboard horizontal midplane of TEXTOR. An array of Langmuir probes has been installed in the plasma scoops to monitor radial decay lengths, electron/ion drift side asymmetries, and to measure total ion currents incident on the neutralizer plates. To complement these diagnostics, a pneumatic scanning double probe has been mounted at the outboard midplane to measure profiles in the scrap-off layer in to the limiter tangency point. Li-beam diagnostics on the top and bottom of TEXTOR are used to measure poloidal asymmetries. During Ohmic discharges, the electron temperature in the center of the scoops (3cm into the SOL) is 8-12eV, tending to decrease with rising line average density in the core. Corresponding edge plasma densities are in the range 2 to 5 x $10^{11}cm^{-3}$. Recent probe measurements indicate that 10-50% more particle current is collected on neutralizer plates with flux tubes connected to the electron drift side on the outboard side of ALT-II. The primary reason for the asymmetric particle collection at the neutralizers is that particle flux e-folding lengths on the electron drift side are longer than on the ion drift side by up to a factor of 2, for non-detached plasmas. These measurements are confirmed by profiles obtained with the fast pneumatic scanning probe, and a Li-beam edge diagnostic[1] located in the bottom of TEXTOR. In this paper, measurements in the edge plasma behind ALT-II are reported to emphasize the role of scrape-off length asymmetries on particle collection by the ALT-II toroidal belt pump limiter.

39747 (UCLA/PPG–1171, pp. 33, Paper 5) **ALT-II toroidal belt pump limiter performance in TEXTOR.** Goebel, D.M.; Conn, R.W.; Corbett, W.J.; Dippel, K.H.; Finken, K.H.; Gauster, W.B.; Hardtke, A.; Koski, J.A.; Kohlhass, W.; McGrath, R.T. California Univ., Los Angeles, CA (USA). Plasma Physics Group. Aug 1988. In *PISCES and ALT-II: Juelich PSI papers.* Order Number DE88017301/JAW. Available from NTIS, PC A06/MF A01.

The Advanced Limiter Test (ALT-II) is a toroidal belt pump limiter in the TEXTOR tokamak. ALT-II is composed of 8 blade segments which form an axisymmetric toroidal belt of 3.4m^2 exposed surface area, located on the outside of the torus at 45° below the horizontal midplane. Ohmic plasma operation with ALT-II as the main limiter is characterized by a line-averaged density range of 5x10^{12} to 5.5x10^{13} cm^{-3} at B_T = 2T and I_p = 340kA, Z_{eff} = 1.1 to 2 and typically 40 to 95% of the power radiated depending on the plasma density. ICRH heating of the plasma with up to 2.6MW of incident power has been achieved, which modifies the scrap-off layer (SOL) and the pump limiter performance. The recycling coefficient in TEXTOR is normally close to one, but helium RG conditioning and baking of the limiter at 400°C is found to lower the recycling coefficient to 0.8 for the order of 10 shots. Measurements by arrays of probes in the SOL and thermocouples in the limiter tiles indicate the flow to the limiter is toroidally symmetric (taking field ripple into account) and poloidally asymmetric. Poloidal asymmetries result in different power and particle fluxes to the ion and electron drift sides of the limiter. The density and power scrape-off lengths are on the order of 1-2 cm and significantly longer on the outside of the torus (electron drift side). In spite of the flow asymmetry favoring the ion drift side near the tangency point, the longer e-folding lengths on the electron side in the SOL result in equal or higher particle collection by the electron side. The probe arrays indicate that during ohmic heating a total of 15 to 20% of the core efflux is incident on the neutralizer plates located in scoops beneath the blades. More particles are collected during ICRH auxiliary heating due to changes in the e-folding lengths and shorter particle confinement times.

39748 (UCLA/PPG–1171, pp. 1, Paper 6) **Boundary asymmetries and plasma flow to the ALT-II toroidal belt pump limiter.** Corbett, W.J.; Goebel, D.M.; Conn, R.W.; McGrath, R.T.; Dippel, K.H.; Finken, K.H. California Univ., Los Angeles, CA (USA). Plasma Physics Group. Aug 1988. In *PISCES and ALT-II: Juelich PSI papers.* Order Number DE88017301/JAW. Available from NTIS, PC A06/MF A01.

The ALT-II toroidal belt pump limiter is constructed with 8 radially adjustable limiter blade segments located 45° below the outboard horizontal midplane of TEXTOR. An array of Langmuir probes installed in the plasma scoops measure the total ion current to each

neutralizer plate, including asymmetries in flow incident from above and below the belt. Recent measurements indicate that 10-50% more current is collected by neutralizers with flux tubes connecting to the electron drift side, on the outboard side of ALT-II. The source of the particle collection asymmetry is deducted from profile measurements in the scrape-off layer (SOL). On the outboard midplane, a scanning double probe measures λ_n=1.4cm, while profiles obtained with a Li-beam diagnostic located at the bottom of TEXTOR show λ_n=0.9cm. The primary source of the asymmetric particle collection at the neutralizers is therefore the difference in e-folding lengths between the electron and ion drift sides. In this paper, we report on measurements in the SOL behind ALT-II to emphasize the role of asymmetric decay lengths on particle collection by the ALT-II toroidal belt pump limiter.

39749 (UCLA/PPG–1171, pp. 2, Paper 7) **Hydrogen pumping and release by graphite under high flux plasma bombardment.** Hirooka, Y.; Leung, W.K.; Conn, R.W.; Goebel, D.M.; Labombard, B.; Nygren, R.; Wilson, K.L. California Univ., Los Angeles, CA (USA). Plasma Physics Group. Aug 1988. In *PISCES and ALT-II: Juelich PSI papers.* Order Number DE88017301/JAW. Available from NTIS, PC A06/MF A01.

Inert gas (helium or argon) plasma bombardment has been found to increase the surface gas adsorptivity of isotropic graphite (POCO-graphite), which can then getter residual gases in a high vacuum system. The inert gas plasma bombardment was carried out at a flux $\sim 1 \times 10^{18}$ ions s^{-1} cm^{-2} to a fluence of the order of 10^{21} ions/cm^2 and at temperatures around 800°C. The plasma bombarding energy was varied between 100 and 200 eV. The gettering speed of the activated graphite surface is estimated to be as large as 25 liters s^{-1} cm^{-2} at total pressures between 10^{-6} and 10^{-7} torr. The gettering capacity estimated is 0.025 torr-liter/cm^2 at room temperature. The gettering capability of graphite can be easily recovered by repeating inert gas plasma bombardment. The activated graphite surface exhibits a smooth, sponge-like morphology with significantly increased pore openings, which correlates with the observed increase in the surface gas adsorptivity. The activated graphite surface has been observed to pump hydrogen plasma particles as well. From calibrated H-alpha measurements, the dynamic hydrogen retention capacity is evaluated to be as large as 2×10^{18} H/cm^2 at temperatures below 100°C and at a plasma bombarding energy of 300 eV.

39750 (UCLA/PPG–1171, pp. 1, Paper 8) **In-situ spectroscopic erosion yield measurement with applications to sputtering and surface morphology alterations.** Leung, W.K.; Hirooka, Y.; Conn, R.W.; Goebel, D.M.; Labombard, B.; Nygren, R. California Univ., Los Angeles, CA (USA). Plasma Physics Group. Aug 1988. In *PISCES and ALT-II: Juelich PSI papers.* Order Number DE88017301/JAW. Available from NTIS, PC A06/MF A01.

An in-situ spectroscopic erosion yield measurement is developed and used to monitor material surface erosion during bombardment by a plasma. The experiments are performed in a plasma that has the characteristics of a fusion tokamak boundary plasma but the technique is applicable to many processes where plasma erosion is important. Erosion yield of materials bombarded in a high flux (up to 10^{18} ion/cm^2/s) plasma environment has been previously studies using weight loss measurements. In the present study, the sputtered flux from a material is monitored by the line emission intensities of atoms eroded from the surface. The line intensities can be used to infer erosion yields after proper calibration. The method agrees well with results from weight loss measurements. Earlier work established that the material surface structure can substantially influence the erosion yield. When a change of surface morphology (e.g., cone formation) occurs, weight loss methods cannot be used to determine the erosion yield. However, the in-situ erosion measurement is suitable and is used to investigate the relation between the on-set of morphology changes and alternations in erosion yield during plasma bombardment. Experiments are reported for copper, as an example of a pure material, and stainless steel, as an example of an alloy system. The formation of surface cones is observed only when both the sample temperature is above a critical value and surface impurities exist. If the source of impurities is removed, or the sample temperature is lowered below the critical value, a surface rough with cones will be returned to a smooth state.

39751 (UCLA/PPG–1171, pp. 2, Paper 2) **ALT-II toroidal belt pump limiter performance in TEXTOR.** Goebel, D.M.; Conn, R.W.; Corbett, W.J.; Dippel, K.H.; Finken, K.H.; Gauster, W.B.; Hardtke, A.; Koski, J.A.; Kohlhaas, W.; McGrath, R.T. California Univ., Los Angeles, CA (USA). Plasma Physics Group. Aug 1988. In *PISCES and ALT-II: Juelich PSI papers.* Order Number DE88017301/JAW. Available from NTIS, PC A06/MF A01.

The Advanced Limiter Test (ALT-II) is a toroidal belt pump limiter in the TEXTOR tokamak. ALT-II is composed of 8 blade segments which form an axisymmetric toroidal belt of 3.4m^2 exposed surface area, located on the outside of the torus at 45° below the horizontal midplane. Ohmic plasma operation with ALT-II as the main limiter is characterized by a line-averaged density range of 5×10^{12} to 5.5×10^{13} cm^{-3} at B_T = 2T and I_p=340kA, Z_{eff} = 1.1 to 2 and typically 40 to 95% of the power radiated depending on the plasma density. ICRH heating of the plasma with up to 2.6MW of incident power has been achieved, which modifies the scrape-off layer (SOL) and the pump limiter performance. Measurements by arrays of probes in the SOL and thermocouples in the limiter tiles indicate the flow to the limiter is toroidally symmetric (taking field ripple into account) and poloidally asymmetric. Poloidal asymmetries result in different power and particle fluxes to the ion and electron drift sides of the limiter. The density and power scrape-off lengths are on the order of 1-2 cm and significantly longer on the outside of the torus (electron drift side). The probe arrays indicate that during ohmic heating a total of 15 to 20% of the core efflux is incident on the neutralizer plates located in scoops beneath the blades. More particles are collected during ICRH auxiliary heating due to changes in the e-folding lengths and shorter particle confinement times. Based on particle removal experiments with pumping on one blade, the total exhaust efficiency of the limiter if pumped at all eight blades is 5 to 10%.

39752 (UCRL–99395) **A nonvaporizing first wall for inertial-confinement-fusion reactors.** Pitts, J.H.; Tabak, M. Lawrence Livermore National Lab., CA (USA). 14 Mar 1989. 6p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890855–11: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989). Order Number DE89009950/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We present a new concept for a stationary inertial-confinement-fusion reactor. The concept uses a sacrificial x-ray and debris shield around each fuel pellet that extends the energy deposition time in the first wall from <10 ns to ~100 μs. This permits the design of a first wall surface that does not vaporize. 6 refs., 2 figs.

39753 Demonstration of efficient full-aperture type I/type II third harmonic conversion on Nova. Wegner, P.J. (Lawrence Livermore National Lab., Livermore, CA (US)); Henesian, M.A.; Marchi, F.T.; Speck, D.R. v.v of Proceedings of the conference on lasers and electro-optics. Optical Society of America, Washington, DC (1988). (CONF-880402–: CLEO '88: OSA/IEEE conference on lasers and electro-optics, Anaheim, CA, USA, 25-29 Apr 1988).

The ten arms of the Nova laser system readily deliver 22.5 kJ of third harmonic radiation in 1-ns pulses to targets for fusion experiments. Frequency conversion experiments conducted on a single arm have produced >7.5 kJ of 3ω radiation in longer (2.5-ns) pulses at the output of a Nova crystal array with 15 kJ of 1ω drive. Equivalent on-target energies (40-60 kJ) in 2-3-ns pulses is available at target chamber center when the laser disks in the output section of the Nova amplifier are replaced with new high-damage threshold glass. The remaining issue facing frequency conversion on Nova is to demonstrate similar 3-ω energy (>40 kJ) on-target at shorter (1-ns) pulse lengths with controlled pulse shape at 1→ drive energies up to 9 kJ. Frequency conversion to 40 kJ of 3→ with precisely shaped pulses is required for future experiments. The authors assembled a full-aperture (74-cm) array of these crystals to test on an arm outfitted with the new laser glass. Measurements of conversion efficiency, pulse time history, and optical quality of the converted beam are reported.

39754 Two dimensional transient heat transfer in HE II. Pfotenhauer, J.M. (9524637); Huang, X. *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics (USA),* 25(2): 1508-1511 (Mar 1989). (CONF-880812–: Applied superconductivity conference, San Francisco, CA, USA, 21-25 Aug 1988).

A comparison is presented of transient heat flow in He II as measured experimentally and as predicted by analysis based on the Gorter-Mellink equation. The geometry is that envisioned for the He II cooling of a SMES system, viz, an annular layer of He II in direct contact with one layer of a solenoid and extending the full height of the coil. A normal zone over a fraction of a turn provides for two dimensional heat flow in the annular layer of He II. The comparison is given for both adiabatic and isothermal boundary conditions at the ends of the channel. The authors find good agreement between the analysis and the experimental data, and thereby verify the usefulness of the analysis for large scale systems. In addition, discrepancies between the analysis and data provide insight into the stability process of the He II cooled superconductor.

39755 Performance of a pneumatic hydrogen-pellet injection system on the Joint European Torus. Combs, S. K. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831(US)); Jernigan, T. C.; Baylor, L. R.; Milora, S. L.; Foust, C. R.; Kupschus, P.; Gadeberg, M.; Bailey, W. *Review of Scientific Instruments (USA)*, 60(8): 2697-2700 (Aug 1989). DOE Contract AC05-84OR21400.

A pneumatic-based, hydrogen isotope pellet injector that was developed at the Oak Ridge National Laboratory (ORNL) has been used in recent plasma fueling experiments on the Joint European Torus (JET). The injector consists of three independent machine-gun-like mechanisms (nominal pellet sizes of 2.7, 4.0, and 6.0 mm in diameter) and features repetitive operation (1–5 Hz) for quasi-steady-state conditions (>10 s). An extensive set of injector diagnostics permits evaluation of parameters for each pellet shot, including speed, mass, and integrity. Pellet speeds range from 1.0 to 1.5 km/s. Over 3700 pellets have been fired with the equipment at JET, with about 1500 pellets shot for plasma fueling experiments. In recent experiments, the system performance has been outstanding, including excellent reproducibility in pellet speed and mass, and a reliability of >98% in delivery of pellets to the plasma.

39756 Magnetic reconnection launcher. Cowan, M. To Dept. of Energy, Washington, DC. USA Patent 4,817,494. 4 Apr 1989. Filed date 6 Apr 1987. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

An electromagnetic launcher is described, which includes a plurality of electrical stages which are energized sequentially in synchrony with the passage of a projectile. Each stage of the launcher includes two or more coils which are arranged coaxially on either closed-loop or straight lines to form gaps between their ends. The projectile has an electrically conductive gap-portion that passes through all the gaps of all the stages in a direction transverse to the axes of the coils. The coils receive an electric current, store magnetic energy, and convert a significant portion of the stored magnetic energy into kinetic energy of the projectile by magnetic reconnection as the gap portion of the projectile moves through the gap. The magnetic polarity of the opposing coils is in the same direction, e.g. N-S-N-S. A gap portion of the projectile may be made from aluminum and is propelled by the reconnection of magnetic flux stored in the coils which causes accelerating forces to act upon the projectile at both the rear vertical surface of the projectile and at the horizontal surfaces of the projectile near its rear. The gap portion of the projectile may be flat, rectangular and longer than the length of the opposing coils and fit loosely within the gap between the opposing coils.

99 GENERAL AND MISCELLANEOUS

Refer also to citation(s) 38750, 38930

39757 (CONF-8907103–1) **Energy technology R and D: What could make a difference.** Reister, D.B. Oak Ridge National Lab., TN (USA). 1989. 12p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From Technology-based confidence building: energy and environment; Santa Fe, NM, USA; 9-14 Jul 1989. Order Number DE89014097/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Two major uncertainties cloud the future energy system: the level of energy demand and the consequences of the greenhouse effect. Energy technology R and D provides technological alternatives for the future energy system. The Oak Ridge National Laboratory (ORNL) recently completed a broad survey of energy technology R and D. The survey revealed a rich variety of options for both end-use technologies and energy supply technologies. However, none of the nonfossil energy sources are ready to substitute for fossil fuels at the scale necessary to mitigate the potential consequences of the greenhouse effect. 1 ref., 1 tab.

39758 (CONF-8907109–1) **Energy: The coin of international understanding.** Zucker, A. Oak Ridge National Lab., TN (USA). 1989. 10p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From Conference on technology-based confidence building: energy and environment; Los Alamos, NM, USA; 9-14 Jul 1989. Order Number DE89014879/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Various aspects of international energy development are discussed. (CBS)

39759 (DOE/ER–0414) **Guide for the preparation of proposals for the pre-freshman engineering program PREP–1990.** USDOE Office of Energy Research, Washington, DC (USA). University and Industry Programs Div. Aug 1989. 29p. Sponsored by DOE Energy Research. Order Number DE89014410/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Pre-Freshman Engineering Program (PREP) will provide funds to colleges and universities for projects aimed at seeking out individuals during junior high school and high school years (7th grade through 10th grade) and providing them with pre-engineering enrichment experiences. These experiences shall consist of activities to identify, motivate and prepare students for engineering studies. Project duration for PREP summer activities should be no less than five weeks and preferably longer. This five-week period is to be committed to the same group of students. Activities may include, but are not limited to, coursework in algebra, physics, chemistry, computer science, problem solving exercises, logic, etc., as well as motivational activities such as field trips and the use of role models. Emphasis is on the individuals identified, regardless of where they may decide to matriculate for undergraduate studies. It is highly desirable that the PREP activities of the proposing institution be correlated with and built upon the broader activities of the national efforts for pre-engineering education. Previous studies have shown that activities in this area should focus on the pre-college years. Therefore, preference will be shown for proposals which promise to positively affect the younger, uncommitted student (in grades 7-10), before firm decisions have been made not to take the appropriate science and mathematics courses.

39760 (INIS-mf–11480) **Annual report of the Institute for Theoretical Physics in Graz, Austria.** Schnizer, B. (ed.). Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik. Nov 1988. 43p. (In German, English). Order Number DE89631627/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A short description and the status of projects in the fields: electrodynamics; quantum mechanics; theoretical solid state physics; transport theory; energy physics and - economy; fusion- and plasma physics; reactor- and radiation physics is given. 20 of them are in INIS scope. (qui).

39761 (OEFZS–4493) **Publications of the Austrian Research Centre Seibersdorf 1976-1985.** Ranz, F.; Nevyjel, A. Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. (Austria). Feb 1989. 181p. (In German). (MI–100/89). Order Number DE89631620/JAW. Available from NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS.

About 3000 publications, written by staff members of the Austrian Research Centre Seibersdorf (OEFZS) within the period 1976-1985 are cited. The bibliography includes citations of journal articles, proceedings, books, technical reports as well as dissertations and diploma works, carried out in Seibersdorf by students of Austrian universities. It covers the subject areas of chemistry, physics, biology, radiation protection, reactor safety, isotope applications, materials technology, environmental research, mathematics and information, electronics and agriculture. 10 refs.

9901 Management

39762 (DOE/RW–0237) **Correspondence control and records management procedures.** USDOE Office of Civilian Radioactive Waste Management, Washington, DC (USA). Jun 1989. 53p. Sponsored by DOE Radioactive Waste Management. Available from OSTI.

This document establishes procedures and policies, and assigns responsibilities for correspondence management and related activities in accordance with pertinent DOE and OCRWM requirements governing correspondence processing, including internal memoranda, and records management. These procedures apply to OCRWM headquarters, but do not apply to Quality Assurance records or classified documents.

39763 (DP-MS–88-144) **Savannah River Plant Business Services Department's Commitment To Excellence.** Mayock, R.F.; Greene, T.W. Westinghouse Savannah River Co., Aiken, SC (USA). 1989. 50p. Sponsored by DOE Defense Programs. DOE Contract AC09-76SR00001;AC09-89SR18035. (CONF-8905174–1: 11. annual spring conference and resource mart, Kansas City, MO, USA, 1-4 May 1989). Order Number DE89011630/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Savannah River Plant (SRP) is located in South Carolina approximately 20 miles southeast of Augusta, Georgia. Today, the total work force level exceeds 18,000 employees including operations, research, and construction personnel. The site is proud of its safety and operating performance during its 38+ years' history. The site is the single largest employer and has the highest payroll in the state of South Carolina. Total land area exceeds 325 square miles. Du Pont built the Plant for the government and then operated it from the time construction was completed in 1953 until March 31, 1989, when Westinghouse Electric Corporation took over. During Du Pont's tenure the Plant was operated under the same corporate policies and procedures as all other Du Pont facilities. In the latter part of the 1970s and into the 1980s, most Du Pont manufacturing facilities began experimenting with changes designed to enhance organizational effectiveness (OE). The success of these efforts in its commercial business led Du Pont corporate executives to insist that SRP undertake similar improvement efforts which finally culminated in SRP's Commitment To Excellence (CTE) program.

9902 Mathematics and Computers

Refer also to citation(s) 37929, 37999, 38116, 38165, 38179, 38197, 38374, 38378, 38424, 38450, 38451, 38460, 38461, 38478, 38663, 38677, 38680, 38685, 38686, 38692, 38752, 38932, 38934, 38935, 38938, 38939, 38948, 38949, 38968, 38989, 38992, 39008, 39092, 39096, 39119, 39277, 39347, 39379, 39404, 39408, 39478, 39543, 39639

39764 (AD-A–204969/0/XAB) **Microsupercomputers: design and implementation. Semiannual Technical Progress report, April-October 1988.** Hennessy, J.L.; Horowitz, M.A. Stanford Univ., CA (USA). Computer Systems Lab. Nov 1988. 20p. Available from NTIS, PC A03/MF A01.

This report details progress in the design and use of micro-supercomputers.

39765 **Deterministic methods for sensitivity and uncertainty analysis in large-scale computer models.** Worley, B.A. (Oak Ridge National Lab., TN (USA)); Oblow, E.M.; Pin, F.G.; Maerker, R.E.; Horwedel, J.E.; Wright, R.Q.; Lucius, J.L. pp. 658 of Geostatistical, sensitivity, and uncertainty methods for ground-water flow and radionuclide transport modeling. Proceedings. Buxton, B.E. (ed.) Battelle Memorial Institute, Columbus, OH (1989). DOE Contract AC05-84OR21400. From Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference; San Francisco, CA, USA; 15-17 Sep 1987.

The fields of sensitivity and uncertainty analysis have traditionally been dominated by statistical techniques when large-scale modeling codes are being analyzed. These methods are able to estimate sensitivities, generate response surfaces, and estimate response probability distributions given the input parameter probability distributions. Because the statistical methods are computationally costly, they are usually applied only to problems with relatively small parameter sets. Deterministic methods, on the other hand, are very efficient and can handle large data sets, but generally require simpler models because of the considerable programming effort required for their implementation. The first part of this paper reports on the development and availability of two systems, GRESS and ADGEN, that make use of computer calculus compilers to automate the implementation of deterministic sensitivity analysis capability into existing computer models. This automation removes the traditional limitation of deterministic sensitivity methods. The second part of the paper describes a Deterministic sensitivity methods. The second part of the paper describes a Deterministic Uncertainty Analysis (DUA) method that uses derivative information as a basis to propagate parameter probability distributions to obtain result probability distributions. The last part of the paper demonstrates the deterministic approach to sensitivity and uncertainty analysis as applied to a sample problem that models the flow of water through a borehole.

39766 (CONF-8809373–1) **Canonical propagators for nonlinear systems: Theory and sample applications.** Cacuci, D.G.; Protopopescu, V. Oak Ridge National Lab., TN (USA). 1989. 16p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. From 3. international workshop on mathematical aspects of fluid and plasma dynamics; Salice Terme (Italy); 26-30 Sep 1988. Order Number DE89014074/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A new canonical formalism for solving general nonlinear systems is presented. Fundamental to this formalism is the construction of forward (advanced) and backward (retarded) propagators that yield the problem's solution exactly, by propagating volume, surface, and initial sources. These propagators also satisfy reciprocity and semigroup properties. Therefore, they represent a generalization to nonlinear systems of the Green's functions from linear theory. Several examples are presented to illustrate the application of the algorithm as well as its numerical advantages over alternative methods. 8 refs.

39767 (FNAL/C–89/124) **High level language memory management on parallel architectures.** Lebrun, P.; Kreymer, A. Fermi National Accelerator Lab., Batavia, IL (USA). May 1989. 6p. Sponsored by DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-890415–8: Computing in high energy physics, Oxford (UK), 10-14 Apr 1989). Order Number DE89015018/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

HEP memory management packages such as YBOS and ZEBRA have been implemented and are currently running on a variety of mainframe computers. These packages were originally designed to run on single CPU engines. Implementation of these packages on parallel machines, loosely or tightly coupled architectures is discussed. ZEBRA (CERN package) on ACP (Fermilab) is presented in detail. Design of memory management system for the new generation of ACP systems or similar parallel architectures are presented. The future of packages such as ZEBRA is not only linked to system architecture, but also to languages issues. We briefly mention penalties in using F77 with respect to other increasingly popular languages in HEP, such as C, on parallel systems. 9 refs.

39768 (JINR-R–10-88-490) **Organization of communication of IBM PC personal computer with microprocessor system via dual-port RAM.** Glejbman, Eh.M.; Malakhov, N.A. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. 6p. (In Russian). Order Number DE89631617/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Organization of communication of microprocessor system in CAMAC standard with PC via dual-port RAM unit and adapter board is proposed. Such organization permits to provide rather simple data exchange between PC and electronic of physical experiment without time losses and without using any communication programs. Besides, the application of RAM dual-port RAM permits to increase volume of address memory of PC by 128 kbyte. 10 refs.; 3 figs.; 1 tab.

39769 (LA-UR–88-4110) **ParaGraph-RTS: A parallel reduction-based run-time system.** Yantis, B.; Rich, D.; Michelsen, R. Los Alamos National Lab., NM (USA). 1989. 8p. Sponsored by

DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890834–1: International conference on parallel processing, St. Charles, IL, USA, 8-12 Aug 1989). Order Number DE89005457/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We are investigating the use of the functional programming paradigm on multiprocessor computers. We have developed a parallel graph reduction run-time system called ParaGraph-RTS (Parallel Graph Reduction) that provides both significant amounts of exploitable parallelism and the robustness to support development of large scientific codes. This system allows us to empirically investigate the functional programming paradigm within computationally intensive application domains. In this paper, we describe an implementation of ParaGraph-RTS on a shared-memory multiprocessor. The implementation strategy reflects insights gained through performance characterizations of the reduction process. Preliminary performance results and analyses are presented. 8 refs., 4 figs.

39770 (ORAU–89/C-140) **1988 workshop on human-machine symbiotic systems proceedings.** Parker, L.E.; Weisbin, C.R. Oak Ridge National Lab., TN (USA); Oak Ridge Associated Universities, Inc., TN (USA). 1989. 196p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. (CESAR–89/19;CONF-881281–: Workshop on human-machine symbiotic systems, Oak Ridge, TN, USA, 5-6 Dec 1988). Order Number DE89013888/JAW. Available from NTIS, PC A09/MF A01 - OSTI; GPO Dep.

This report presents the proceedings of the 1988 Workshop on Human-Machine Symbiotic Systems. Held December 5–6, 1988, in Oak Ridge, Tennessee, the workshop served as a forum for the discussion of several critical issues in human-machine symbiosis: human-machine communication, autonomous task planning and execution monitoring for heterogeneous agents, dynamic task allocation, human-machine system architecture, and machine learning via experience and human observation. The presentation of overview papers by invited keynote speakers provided a background for the breakout session discussions in these five areas. The full powers furnished by the speakers are included in the proceedings, along with written summaries of the group discussions that report session conclusions and recommendations for future work.

39771 (ORNL/TM–10826) **The T_TX report macro package.** Barry, K.T.; Ketterer, S.P.; McGaffey, R.W. Oak Ridge National Lab., TN (USA). Jun 1989. 34p. Sponsored by DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89014346/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The following document is a user's guide to production of Martin Marietta Energy Systems reports using the tyesetting program T_EX. Much of the standard formatting of these reports has been automated, including headings, figures, and contents. This automation will improve the speed and accuracy of user input. Each feature is explained in detail along with examples. A basic familiarity with T_E and its commands is assumed. 2 refs., 3 figs.

39772 (SAND–85-2348) **Sandia software guidelines: Volume 5, Tools, techniques, and methodologies.** Sandia National Labs., Albuquerque, NM (USA). Jul 1989. 91p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89014373/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This volume is one in a series of Sandia Software Guidelines intended for use in producing quality software within Sandia National Laboratories. This volume describes software tools and methodologies available to Sandia personnel for the development of software, and outlines techniques that have proven useful within the Laboratories and elsewhere. References and evaluations by Sandia personnel are included. 6 figs.

39773 (SAND–89-0550C) **Parallel graphics algorithms on a 1024-processor hypercube.** Benner, R.E. Sandia National Labs., Albuquerque, NM (USA). 1989. 13p. Sponsored by DOE Energy Research. DOE Contract AC04-76DP00789. (CONF-890372–12: 4. hypercube, concurrent computers and applications, Monterey, CA (USA), 6-8 Mar 1989). Order Number DE89015492/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We have developed four parallel graphics algorithms for visualization of complex problems in PDE simulations, radar simulation, and other large applications on a 1024-node ensemble with a 16-node graphics device. We discuss the impact of system parameters on algorithm development and performance. Algorithmic issues include multistage routing of graphics data through the ensemble, non-hypercube mappings from the ensemble to the graphics system, synchronization between ensemble and graphics nodes, and synchronization between graphic nodes. These issues apply to both the present and anticipated future systems which combine highly parallel ensembles and parallel I/O devices. "Best" solutions are described for routing, mapping and synchronization on the current hardware. Implications are discussed for future hardware and software for massively parallel computers. 6 refs., 2 figs., 2 tabs.

39774 (SAND–89-0737C) **Integrating security analysis and safeguards software engineering.** Spencer, D.D.; Axline, R.M. Sandia National Labs., Albuquerque, NM (USA). 1989. 5p. Sponsored by DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8906185–1: 5. annual joint government-industry symposium on security technology, Virginia Beach, VA, USA, 7-9 Jun 1989). Order Number DE89012678/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

These initiatives will work together to provide more secure safeguards software, as well as other critical systems software. The resulting design tools and methodologies, the evolving guidelines for software security, and the adversary-resistant software components will be applied to the software design at each stage to increase the design's inherent security and to make the design easier to analyze. The resident hardware monitor or other architectural innovations will provide complementary additions to the design to remove some of the burden of security from the software. The security analysis process, supported by new analysis methodologies and tools, will be applied to the software design as it evolves in an attempt to identify and remove vulnerabilities at the earliest possible point in the safeguards system life cycle. The result should be better and more verifiably secure software systems.

39775 (SOL–89-6) **Primal barrier methods for linear programmming: Technical report.** Marxen, A. Stanford Univ., CA (USA). Dept. of Operations Research. Jun 1989. 77p. Sponsored by DOE Energy Research. DOE Contract FG03-87ER25030. Order Number DE89014905/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The linear program min c^Tx subject to $Ax = b$, $x \geq 0$, is solved by the projected Newton barrier method. The method consists of solving a sequence of subproblems of the form min $c^Tx - \mu\Sigma \ln x$; subject to $Ax = b$. Extensions for upper bounds, free and fixed variables are given. A linear modification is made to the logarithmic barrier function, which results in the solution being bounded in all cases. It also facilitates the provision of a good starting point. The solution of each subproblem involves repeatedly computing a search direction and taking a step along this direction. Ways to find an initial feasible solution, step sizes and convergence criteria are discussed. Like other interior-point method for linear programming, this method solves a system of the form $AH^{-1}A^Tq = y$, where H is diagonal. This system can be very ill-conditioned and special precautions must be taken for the Cholesky factorization. The matrix A is assumed to be large and sparse. Data structures and algorithms for the sparse factorization are explained. In particular, the consequences of relatively dense columns in A are investigated and a Schur-complement method is introduced to maintain the speed of the method in these cases. An implementation of the method was developed as part of the research. Results of extensive testing with medium to large problems are presented and the testing methodologies used are discussed. 51 refs.

39776 (UCRL–101197) **Detecting stability barriers in BDF [Backward Differentiation Formula] solvers.** Hindmarsh, A.C. Lawrence Livermore National Lab., CA (USA). 1 Jun 1989. 9p. Sponsored by DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8907106–1: Institute of Mathematics and its applications: conference on computational ordinary differential equations, London (UK), 3-7 Jul 1989). Order Number DE89014053/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

When a Backward Differentiation Formula method is used on an ODE problem with a damped but strongly oscillatory mode, the step

size may be unduly limited if the order is three or more. The performance of existing BDF codes in this situation varies from poor to fair. Analysis of the computed solution and related quantities in model problems yields a set of relationships that allow for direct detection of the stability barrier. The analysis is fairly easy for a complex scalar model problem, but for a corresponding real system the diagonalizing transformation greatly complicates the relationships. But a solution of them leads to an algorithm for determining whether a dominant oscillatory mode is limiting the step size, and to estimate the magnitude of the associated characteristic root. It uses only the norms of the scaled derivatives of the solution, but bears no resemblance to the common practice of demanding monotonicity among these norms.

39777 A general topology Gudunov method. Dukowicz, J. K. (Theoretical Division, Group T-3, Los Alamos National Laboratory, Los Alamos, New Mexico 87545(US)); Cline, M. C.; Addessio, F. L. *Journal of Computational Physics (USA),* 82(1): 29-63 (May 1989).

We describe a numerical technique for solving 2-dimensional compressible multimaterial problems using a general topology mesh. Multimaterial problems are characterized by the evolution. Computational methods based on more conventional fixed-connectivity quadrilateral meshes do not have adequate flexibility to follow convoluted interface shapes and frequently fail due to excessive mesh distortion. The presnt method is based on a mesh of arbitrary polygonal cells. Because this mesh is dual to a triangulation, its topology is unrestricted and it is able to accommodate arbitrary boundary shapes. Additionally, this mesh is able to quickly and smoothly change local mesh resolution, thus economizing on the number of mesh cells, and it is able to improve mesh isotropy because in a region of uniform mesh the cells tend to become regular hexagons. The underlying algorithms are based on those of the CAVEAT code. These consist of an explicit, finite-volume, cell-centered, arbitrary Lagrangian-Eulerian (ALE) technique, coupled with the Godunov method, which together are readily adaptable to a general topology mesh. Several special techniques have been developed for this extension to a more general mesh. They include an interface propagation scheme based on Huygens' construction, a "near-Lagrangian" mesh rezoning algorithm that minimizes advection while enhancing mesh regularity, an efficient global remapping algorithm that is capable of conservatively transferring quantities from one general mesh to another and various mesh restructering algorithms, such as mesh reconnection, smoothing, and point addition and deletion. © 1989 Academic Press, Inc.

39778 Expert system for quality control in bibliographic databases. Todeschini, C. (International Atomic Energy Agency, Vienna (Austria)); Farrell, M.P. *Journal of the American Society for Information Science (USA),* 40(1): 1-11 (1989). DOE Contract AC05-84OR21400.

An Expert System is presented that can identify errors in the intellectual decisions made by indexers when categorizing documents into an a priori category scheme. The system requires the compilation of a Knowledge Base that incorporates in statistical form the decisions on the linking of indexing and categorization derived from a preceding period of the bibliographic database. New input entering the database is checked against the Knowledge Base, using the descriptor indexing assigned to each record, and the system computed a value for the match of each record with the particular category chosen by the indexer. This category match value is used as a criterion for identifying those documents that have been erroneously categorized. The system was tested on large sample of almost 26,000 documents, representing all the literature falling into ten of the subject categories of the Energy Data Base during the five year period 1980-1984. For valid comparisons among categories, the Knowledge Base must be constructed with an approximately equal number of unique descriptors for each subject category. The system identified those items with high probability of having been erroneously categorized. These items, constituting up to 5% of the sample, were evaluated manually by subject specialists for correct categorization and then compared with the results of the Expert System. Of those pieces of literature deemed by the system to be erroneously categorized, about 75% did indeed belong to a different category. This percentage, however, is dependent on the level at which the threshold on the category match value is set. With a lower threshold value, the percentage can be raised to 90%, but this is accompanied by a lowering of the absolute number of wrongly categorized records caught by the system. The Expert System can be considered as a first step to complete semiautomatic categorizing system.

39779 High speed, very large (8 megabyte) first in/first out buffer memory (FIFO). Baumbaugh, A.E.; Knickerbocker, K.L. To Dept. of Energy, Washington, DC. USA Patent 4,809,232. 28 Feb 1989. Filed date 16 Dec 1986. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a fast FIFO (First In First Out) memory buffer capable of storing data at rates of 100 megabytes per second. The invention includes a data packer which concatenates small bit data words into large bit data words, a memory array having individual data storage addresses adapted to store the large bit data words, a data unpacker into which large bit data words from the array can be read and reconstructed into small bit data words, and a controller to control and keep track of the individual data storage and addresses in the memory array into which data from the packer is being written and data to the unpacker is being read.

9903 Information Handling

Refer also to citation(s) 38406, 38419, 38473, 38933, 39269

39780 (LPC–86-10) **Proposal for the data acquisition system of the barrel rich.** Brunet, J.M.; Herniou, E.; Jejcic, A.; Tristram, G. College de France, 75 - Paris (France). Lab. de Physique Corpusculaire. 10 Mar 1986. 8p. (DELPHI–86-43;DAS–29;RICH–17). Order Number DE89781512/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

Here we describe the data acquisition system proposed for the Barrel RICH readout of the DELPHI experiment. It is based on F/B time digitizers read out by crate processors, that can perform formatting and processing of the data as well as monitoring, and a multi event buffer located in the Equipment computer crate. All the electronic modules used are briefly described and a precise timing for the trigger phase and the read out phase is proposed. Finally a possible hardware organization is suggested.

Corporate Author Index

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CONF-870812–		(9. biennial international conference on structural mechanics in reactor technology (SMIRT-9); Lausanne (Switzerland); 17-21 Aug 1987)			
	14:38361				
	14:38381				
CONF-8708275–		(American Chemical Society Division of Fuel Chemistry meeting; New Orleans, LA (USA); 30 Aug - 7 sep 1987)			
	14:37922				
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	14:37924				
CONF-870917–		(ANS/ENS international conference on fast breeder reactor systems: experience gained and path to economical power generation; Richland, WA (USA); 13-17 Sep 1987)			
16	14:38435	*See* HEDL-SA–3701			
CONF-8709295–		(CERN accelerator school course on advanced accelerator physics; Berlin, Germany, F.R.; 14-25 Sep 1987)			
	14:39003	*See* CERN–89-01			
CONF-8709440–		(5. International conference on nuclei far from stability; Rosseau Lake, CA, USA; 14-19 Sep 1987)			
	14:39540	*See* ISN–87-89			
CONF-8709445–		(6. quarterly meeting of the Canadian Heavy Oil Association; Calgary, Canada; 22 Sep 1987)			
	14:37938	*See* CHOA–8709			
	14:38038	*See* CHOA–8711			
CONF-871036–		(3. international conference on fusion reactor materials (ICFRM-3); Karlsruhe, Germany, F.R.; 4-8 Oct 1987)			
38	14:38155	*See* EGG-M–08487			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-8710478–		(39. annual convention of the Western Canada Water and Wastewater Association; Saskatoon, Canada; 21-23 Oct 1987)			
	14:39174	*See* WCWWA–8710			
CONF-8711195–		(American Nuclear Society winter meeting; Los Angeles, CA, USA; 15-19 Nov 1987)			
6	14:38379	*See* WHC-SA–0096			
CONF-880122–		(5. symposium on space nuclear power systems; Albuquerque, NM, USA; 11-14 Jan 1988)			
23	14:38421	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013652/JAW	MF-520
CONF-8802136–		(2. workshop on elementary-particle picture of the universe; Tsukuba, Japan; 4-6 Feb 1988)			
	14:39066	*See* KEK–88-5			
CONF-880385–		(8. ESRI annual user conference; Palm Springs, CA, USA; 21-25 Mar 1988)			
2	14:39148	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012339/JAW	MF-402
CONF-8804282–		(Task force meeting on public information of food irradiation; Cadarache, France; 18-21 Apr 1988)			
	14:39281	*See* IAEA-TECDOC–490			
CONF-8804288–		(Symposium on negative ion sources and their applications; Tsukuba (Japan); 5-6 Apr 1988)			
	14:39018	*See* KEK–88-7			
CONF-880457–		(10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA; 10-14 Apr 1988)			
	14:38312	American Society of Mechanical Engineers, 345 East 47 St., New York, NY 10017			
CONF-8805300–		(Meeting of the French Society of the Heat Engineers; Paris-La-Defense, France; 31 May 1988)			
	14:38844	*See* CEA-CONF–9765			
CONF-8805308–		(Quarterly meeting of the Canadian Heavy Oil Association; Calgary, Canada; 10 May 1988)			
	14:37985	*See* CHOA–8805			
CONF-880558–		(Uranium hexafluoride–safe handling, processing, and transporting conference; Oak Ridge, TN, USA; 24-26 May 1988)			
	14:38104	*See* CEA-DAS–554			
CONF-8806117–		(3. international conference on nucleus nucleus collisions; Saint-Malo, France; 6-11 Jun 1988)			
	14:39482	*See* IPNO-DRE–88-16			
CONF-8806231–		(International Atomic Energy Agency (IAEA) advisory group meeting on atomic and molecular data for radiotherapy; Vienna, Austria; 13-16 Jun 1988)			
2	14:39269	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013647/JAW	MF-600
CONF-8806235–		(International conference on advanced technology and particle physics; Como, Italy; 12-17 Jun 1988)			
	14:39084	*See* LAPP-EXP–88-14			
	14:39085	*See* LAPP-EXP–88-15			
8	14:39033	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015715/JAW	MF-414
CONF-8806363–		(Fouling and corrosion probe workshop; Chicago, IL, USA; 23 Jun 1988)			
	14:38325	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012686/JAW	MF-310; STD-310
CONF-8806385–		(14. International congress on electric contacts; Paris, France; 20-24 Jun 1988)			
	14:39031	*See* CEA-CONF–9636			
CONF-8806386–		(2. workshop on Wendelstein VII-X; Schloss-Ringberg, DE, USA; 13-16 Jun 1988)			
	14:39701	*See* EUR–11705			
CONF-880724–		(25. American Society of Mechanical Engineers/American Institute of Chemical Engineers/American Nuclear Society national heat transfer conference; Houston, TX, USA; 24-27 Jul 1988)			
	14:39000	*See* N–89-18664			

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CONF-880787–		(3. international symposium on the synthesis and applications of isotopically labeled compounds; Innsbruck, Austria; 17-21 Jul 1988)			
7	14:38908	*See* LBL–25588			
CONF-880807–		(4. UNITAR/UNDP international conference on heavy crude and tar sands; Edmonton, Canada; 7-12 Aug 1988)			
	14:38032	*See* AOSTRA–1988			
	14:38048	*See* AOSTRA–8808			
CONF-880812–		(Applied superconductivity conference; San Francisco, CA, USA; 21-25 Aug 1988)			
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CONF-8808141–		(3. international conference on synchrotron radiation instrumentation; Tsukuba, Japan; 29 Aug - 2 sep 1988)			
13	14:39011	*See* LBL–26862			
CONF-880903–		(Spectrum '88: international topical meeting on nuclear and hazardous waste management; Pasco, WA, USA; 11-15 Sep 1988)			
56	14:38186	*See* WHC-SA–0199			
CONF-8809105–		(SPIE O-E Laser: international symposium and exhibition on fiber optics, optoelectronics and laser applications; Boston, MA, USA; 6-10 Sep 1988)			
	14:39090	*See* CEA-CONF–9817			
CONF-8809118–		(20. summer school on nuclear structure studies by means of nuclear reactions: heavy ions in nuclear and atomic physics; Mikolajki, Poland; 2-11 Sep 1988)			
	14:39503	*See* GANIL-P–88-15			
CONF-8809142–		(American Council for an Energy Efficient Economy conference; Pacific Grove, CA, USA; 3 Sep 1988)			
3	14:38350	*See* PNL-SA–15585			
CONF-8809161–		(Symposium on research with Argonne premium coal samples; Los Angeles, CA, USA; 25-30 Sep 1988)			
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CONF-8809273–		(Coal liquefaction; Los Angeles, CA, USA; 25-30 Sep 1988)			
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Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
	14:37864				
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	14:37903				
CONF-8809373–		(3. international workshop on mathematical aspects of fluid and plasma dynamics; Salice Terme (Italy); 26-30 Sep 1988)			
1	14:39766	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014074/JAW	MF-405
CONF-8810209–		(27. Hanford life sciences symposium on health and the environment; Richland, WA, USA; 18-21 Oct 1988)			
13	14:39342	*See* PNL-SA–16167			
CONF-881024–		(TMI-2 accident materials behavior, plant technology and recovery; Washington, DC, USA; 30 Oct - 4 nov 1988)			
15	14:39155	*See* BNL–42394			
CONF-8810394–		(10. Canadian waste management conference; Winnipeg, Canada; 25-27 Oct 1988)			
	14:38739	*See* EC–E40-11/3-1988			
CONF-8810395–		(Nuclear power day; Rez, Czechoslovakia; 26 Oct 1988)			
	14:38366	*See* INIS-mf–11481			
CONF-8810398–		(National weatherization state manager's conference; St. Louis, MO, USA; 3-6 Oct 1988)			
Summ.	14:38656	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014555/JAW	MF-350
CONF-8811128–		(18. conference on toxicology; Fairborn, OH, USA; 1-3 Nov 1988)			
2	14:39127	*See* UCRL–99592			
CONF-8811199–		(Workshop on scintillating fiber detector development for the SSC; Batavia, IL, USA; 14-16 Nov 1988)			
3-App.II	14:39034	*See* DOE/ER/40372–T2			
CONF-8811239–		(Colloquium on on separation processes in radiochemical practice; Dresden, German Democratic Republic; 8 Nov 1988)			
	14:38864	*See* INIS-mf–11471			
CONF-881227–		(Separation technology workshop for coal gasification; Morgantown, WV, USA; 8 Dec 1988)			
	14:37832	*See* DOE/METC–89/6100			
CONF-881260–		(Conference on future industrial prospects of membrane processes; Bruxelles, Belgium; 6-7 Dec 1988)			
	14:38024	*See* CEA-CONF–9772			
CONF-881281–		(Workshop on human-machine symbiotic systems; Oak Ridge, TN, USA; 5-6 Dec 1988)			
	14:39770	*See* ORAU–89/C-140			
CONF-890115–		(3. conference on medical imaging; Newport Beach, CA, USA; 29 Jan - 3 feb 1989)			
2	14:39274	*See* LBL–25451			
CONF-8902106–		(NO_x control conference; Industry, CA, USA; 7-8 Feb 1989)			
1	14:37920	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012388/JAW	MF-105
CONF-8902118–		(International Energy Agency workshop on fusion materials irradiation facilities; San Diego, CA, USA; 14-17 Feb 1989)			
1	14:39742	*See* LA-UR–89-2127			
CONF-8902122–		(Results and perspectives in particle physics; LaThuile, Italy; 26 Feb - 4 mar 1989)			
1	14:39429	*See* SLAC-PUB–4995			
2	14:39427	*See* SLAC-PUB–4971			
CONF-8903112–		(Waste management '89; Tucson, AZ, USA; 1 Mar 1989)			
3	14:38170	*See* PNL-SA–16234			
CONF-8903132–		(24. Rencontres de Moriond: electroweak interactions and unified theories; Les Arcs, France; 5-12 Mar 1989)			
7	14:39431	*See* SLAC-PUB–5012			
8	14:39417	*See* BNL–42925			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-8903134--		(Circum-Pacific energy and minerals conference; San Jose, Costa Rica; 5-8 Mar 1989)			
1	14:38318	*See* LA-UR-89-1640			
CONF-8903137--		(Workshop on physics at UNK; Protvino, USSR; 20-25 Mar 1989)			
1	14:39416	*See* ANL-HEP-CP-89-49			
CONF-8903142--		(Workshop/symposium on radiation protection: past and future; Chalk River, Canada; 20-22 Mar 1989)			
1	14:39335	*See* PNL-SA-16761			
CONF-8903143--		(24. Recontres de Moriond: new results in hadronic interactions; Les Arcs, France; 12-18 Mar 1989)			
1	14:39510	*See* BNL-42848			
CONF-890335--		(13. particle accelerator conference; Chicago, IL, USA; 20-23 Mar 1989)			
223	14:39380	*See* LBL-26404			
224	14:39026	*See* LBL-25931			
225	14:39025	*See* LBL-25930			
226	14:39007	*See* LBL-25906			
227	14:39027	*See* SLAC-PUB-4890			
229	14:39024	*See* LBL-25916			
231-Vugraphs	14:39009	*See* BNL-42938			
CONF-890358--		(Society of Photo-Optical Instrumentation Engineers conference on applications of artificial intelligence; Orlando, FL, USA; 28-30 Mar 1989)			
5	14:39095	*See* UCRL-99801			
CONF-890372--		(4. hypercube, concurrent computers and applications; Monterey, CA (USA); 6-8 Mar 1989)			
12	14:39773	*See* SAND-89-0550C			
CONF-890379--		(Workshop on calorimetry for the SSC; Tuscaloosa, AL (USA); 13-17 Mar 1989)			
10	14:39418	*See* FNAL/C-89/117-E			
CONF-890401--		(197. national meeting of the American Chemical Society; Dallas, TX, USA; 9-14 Apr 1989)			
13	14:37835	*See* LBL-27175			
CONF-890415--		(Computing in high energy physics; Oxford (UK); 10-14 Apr 1989)			
8	14:39767	*See* FNAL/C-89/124			
CONF-8904226--		(12. international workshop on weak interactions and neutrinos; Ginosar, Israel; 9-14 Apr 1989)			
4	14:39030	*See* SLAC-PUB-4998			
CONF-8904236--		(Annual chemical congress; 31. national organic symposium; Hull, UK; Ithaca, NY, USA; 4-7 Apr 1989; 18-22 jun 1989)			
1	14:38883	*See* LBL-27164			
CONF-8904237--		(Midwest conference on laser materials processing/clinical applications; Cincinnati, OH, USA; 20 Apr 1989)			
1	14:39104	*See* MLM-3587(OP)			
CONF-8904238--		(3. national conference on undergraduate research; San Antonio, TX, USA; 27-29 Apr 1989)			
1	14:38792	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014668/JAW	MF-404
CONF-8904241--		(Sanibel Symposia; St. Augustine, FL, USA; 1-8 Apr 1989)			
1	14:38884	*See* PNL-SA-16623			
CONF-8904242--		(International congress on optical science and engineering; Paris, France; 24-28 Apr 1989)			
1	14:39263	*See* BNL-42829			
CONF-890480--		(Conference on oxygen disorder effects in high T_c superconductors; Trieste, Italy; 18-21 Apr 1989)			
1	14:38798	*See* LBL-27267			
CONF-890498--		(Annual controlled fusion theory conference: international Sherwood theory meeting; San Antonio, TX, USA; 3-5 Apr 1989)			
1	14:39655	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013057/JAW	MF-420
CONF-8905120--		(8. American Physical Society topical conference on radio frequency power in plasmas; Irvine, CA, USA; 1-3 May 1989)			
19	14:39699	*See* DOE/ET/51013-266			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-8905141--		(5. international conference on electrostatic accelerators and associated boosters; Strasbourg, France; 24-27 May 1989)			
2	14:39004	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014071/JAW	MF-414
CONF-8905144--		(Tau-Charm workshop; Stanford, CA, USA; 23-27 May 1989)			
1	14:39430	*See* SLAC-PUB-5007			
CONF-8905145--		(COALPREP '89: 6th international coal preparation exhibition and conference; Lexington, KY, USA; 2-4 May 1989)			
1	14:37825	*See* DOE/PETC/TR-89/7			
CONF-8905146--		(22. Jerusalem symposium on quantum chemistry; Jerusalem (Israel); 15-18 May 1989)			
3	14:38292	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015701/JAW	MF-401
CONF-890517--		(10. symposium on microdosimetry; Rome, Italy; 21-26 May 1989)			
3	14:39332	*See* PNL-SA-16297			
CONF-8905174--		(11. annual spring conference and resource mart; Kansas City, MO, USA; 1-4 May 1989)			
1	14:39763	*See* DP-MS-88-144			
CONF-8905177--		(Electric Power Research Institute demand side management conference; Cincinnati, OH, USA; 2-4 May 1989)			
1	14:38683	*See* PNL-SA-16592			
CONF-8905178--		(6. National Aeronautics and Space Administration nondestructive evaluation workshop; Houston, TX, USA; 23-26 May 1989)			
1	14:38447	*See* PNL-SA-16923			
2	14:38815	*See* PNL-SA-16952			
CONF-8905179--		(8. Pfefferkorn conference on fundamental beam interactions with solids for microscopy, microanalysis and microlithography; Park City, UT, USA; 7-12 May 1989)			
1	14:39613	*See* PNL-SA-16890			
CONF-8905180--		(Technical steering panel meeting; Toppenish, WA, USA; 19-20 May 1989)			
1	14:39597	*See* PNL-SA-17035-HEDR			
CONF-8905182--		(Organic acids in aquatic ecosystems; Berlin, Germany, F.R.; 7-12 May 1989)			
1	14:39165	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014880/JAW	MF-402
CONF-8905183--		(Workshop on physics at the main injector; Batavia, IL, USA; 16-18 May 1989)			
1	14:39428	*See* SLAC-PUB-4992			
CONF-8905187--		(WEIN '89; Montreal, Canada; May 1989)			
1	14:39495	*See* DOE/ER/40481-3			
CONF-890521--		(8. international conference on thermal destruction of hazardous, radioactive, infectious and mixed wastes; Knoxville, TN, USA; 1-5 May 1989)			
11	14:38171	*See* PNL-SA-16584			
CONF-890545--		(6. conference on real-time computer applications in nuclear, particle and plasma physics; Williamsburg, VA, USA; 15-18 May 1989)			
6	14:39008	*See* SLAC-PUB-4963			
7	14:39032	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015697/JAW	MF-414
CONF-890546--		(Seminar on fission product transport processes in reactor accidents; Dubrovnik, Yugoslavia; 22-26 May 1989)			
8	14:38408	*See* SAND-89-1600C			
CONF-890582--		(Biological processing of coal and coal-derived substances; Palo Alto, CA (USA); 16-17 May 1989)			
2	14:37885	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015161/JAW	MF-401
CONF-890610--		(American Solar Energy Society annual meeting; Denver, CO, USA; 19-23 Jun 1989)			
6	14:39093	*See* PNL-SA-17003			
CONF-8906119--		(Powder metallurgy conference; San Diego, CA, USA; 11-14 Jun 1989)			
2	14:38771	*See* PNL-SA-16378			
3	14:38775	*See* SAND-89-1003C			
CONF-8906120--		(4. international symposium for the Society of Radiological Protection; Malvern, UK; 4-9 Jun 1989)			
2	14:39334	*See* PNL-SA-16660			

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CONF-8906134–		(24. AIAA thermophysics conference; Buffalo, NY, USA; 11-15 Jun 1989)			
2	14:39404	*See* SAND–89-1237C			
CONF-8906135–		(International congress on technology and technology exchange; New York, NY, USA; 28 Jun 1989)			
2	14:38793	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014769/JAW	MF-365
CONF-890615–		(Building simulation '89; Vancouver, Canada; 23-24 Jun 1989)			
1	14:38682	*See* PNL-SA–16492			
CONF-8906150–		(3. international conference on microcomputers in transportation; San Francisco, CA, USA; 21-23 Jun 1989)			
2	14:38685	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014095/JAW	MF-000
CONF-8906152–		(Annual chemical congress; 31. national organic symposium; Hull, UK; Ithaca, NY, USA; 4-7 Apr 1989; 18-22 jun 1989)			
1	14:38883	*See* LBL–27164			
CONF-8906154–		(28. Liege international astrophysical colloquium on our changing atmosphere; Liege, Belgium; 26-30 Jun 1989)			
1	14:39110	*See* BNL–42744			
CONF-8906157–		(12. symposium on ion sources and ion-assisted technology; Tokyo, Japan; 5-7 Jun 1989)			
1	14:38811	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014044/JAW	MF-404
2	14:38769	*See* LBL–27187			
CONF-8906158–		(11th international conference on he HTGR; DIMITROVGRAD, USSR; 19-20 Jun 1989)			
1	14:38434	*See* GA-A–19714			
CONF-8906159–		(6. conversation in the discipline biomolecular stereodynamics; Albany, NY, USA; 6-10 Jun 1989)			
1	14:39207	*See* LA-UR–89-2198			
2	14:39206	*See* LA-UR–89-1989			
3	14:39216	*See* PNL-SA–16764			
CONF-8906160–		(Yamada conference on nuclear weak process and nuclear structure; Osaka, Japan; 12-15 Jun 1989)			
1	14:39423	*See* LA-UR–89-1966			
2	14:39424	*See* LA-UR–89-2010			
CONF-8906161–		(Ion beam analysis conference; Kingston, Canada; 26-30 Jun 1989)			
1	14:39485	*See* SAND–89-0902C			
4	14:39604	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015062/JAW	MF-411
CONF-8906162–		(OECD seminar-workshop on NJOY and THEMIS and the NEA data bank; Saclay, France; 20-21 Jun 1989)			
1	14:39478	*See* LA-UR–89-2057			
CONF-8906163–		(33. international conference on electron, ion and photon beam technology; Monterey, CA (USA); Jun 1989)			
1	14:38994	*See* UCRL–101177			
CONF-8906164–		(10. symposium on thermophysical properties; Gaithersburg, MD, USA; 20-23 Jun 1989)			
1	14:38767	*See* LA-UR–89-2105			
CONF-8906166–		(NATO Advanced Study Institute summer school of enzymatic and model carboxylation and reduction reactions for carbon dioxide utilization; Bari (Italy); 17-28 Jun 1989)			
1	14:39203	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014066/JAW	MF-408
CONF-8906168–		(International conference on selected topics in nuclear structure; Dubna (USSR); 20-24 Jun 1989)			
1	14:39511	*See* BNL–42975			
CONF-8906169–		(International Astronautics Federation conference on space power; Cleveland, OH, USA; 5-7 Jun 1989)			
1	14:38688	*See* UCRL–101139			
CONF-8906171–		(Special session of the summer American Society of Limnology and Oceanography; Fairbanks, AK, USA; 18-22 Jun 1989)			
1-Vugraphs	14:39162	*See* DP-MS–88-252			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-8906185–		(5. annual joint government-industry symposium on security technology; Virginia Beach, VA, USA; 7-9 Jun 1989)			
1	14:39774	*See* SAND–89-0737C			
CONF-890619–		(34. annual meeting of the Health Physics Society; Albuquerque, NM, USA; 25-29 Jun 1989)			
6	14:39339	*See* WSRC-RP–89-185			
7	14:39333	*See* PNL-SA–16533			
8	14:38409	*See* WHC-SA–0503			
CONF-890621–		(International conference on narrow-gap semiconductors and related materials; Gaithersburg, MD, USA; 12-15 Jun 1989)			
1	14:38773	*See* SAND–89-0324C			
CONF-890631–		(International symposium on packaging and transporting of radioactive materials; Washington, DC, USA; 11-16 Jun 1989)			
55	14:38928	*See* GA-A–19419			
56	14:38929	*See* GA-A–19420			
59	14:38137	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015041/JAW	MF-820
CONF-890671–		(27. symposium on engineering aspects of magnetohydrodynamics (SEAM); Reno, NV (USA); 27-29 Jun 1989)			
1	14:38642	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015138/JAW	MF-112
2	14:38643	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015132/JAW	MF-112
CONF-890673–		(IWGFR specialists meeting on advanced controls for fast reactors; Argonne, IL (USA); 20-22 Jun 1989)			
3	14:38373	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015042/JAW	MF-530
CONF-890692–		(82. Air and Waste Management Association annual meeting and exhibition; Anaheim, CA, USA; 25-30 Jun 1989)			
14	14:39122	*See* PNL-SA–17105			
15	14:39121	*See* PNL-SA–17042			
16	14:38684	*See* PNL-SA–16716			
17	14:39111	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015131/JAW	MF-902
18	14:37919	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015137/JAW	MF-105
CONF-890703–		(International conference on ion sources; Berkeley, CA, USA; 9-15 Jul 1989)			
11	14:39372	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014881/JAW	MF-421
CONF-890705–		(8. international zeolite conference; Amsterdam, Netherlands; 10-14 Jul 1989)			
1	14:38483	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014091/JAW	MF-404
CONF-890710–		(5. international conference on megagauss magnetic field generation and related topics; Novosibirsk, USSR; 3-7 Jul 1989)			
16-Draft	14:38937	*See* SAND–88-3310C			
CONF-8907102–		(First international conference on inorganic membranes; Montpellier (France); 3-6 Jul 1989)			
1	14:38097	*See* K/QT–249/P			
CONF-8907103–		(Technology-based confidence building: energy and environment; Santa Fe, NM, USA; 9-14 Jul 1989)			
1	14:39757	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014097/JAW	MF-400
CONF-8907104–		(6. symposium on coastal and ocean management; Charleston, SC (USA); 11-14 Jul 1989)			
1	14:39112	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014077/JAW	MF-402
CONF-8907106–		(Institute of Mathematics and its applications: conference on computational ordinary differential equations; London (UK); 3-7 Jul 1989)			
1	14:39776	*See* UCRL–101197			
CONF-8907107–		(American Society of Nondestructive Testing topical conference; Seattle, WA (USA); 24-27 Jul 1989)			
2	14:38949	*See* UCRL–101264			
3	14:39096	*See* UCRL–101242			
CONF-8907109–		(Conference on technology-based confidence building: energy and environment; Los Alamos, NM, USA; 9-14 Jul 1989)			
1	14:39758	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014879/JAW	MF-400

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CONF-890718–		(International conference on materials and mechanisms of superconductivity - high-temperature superconductors; Stanford, CA, USA; 23-28 Jul 1989)			
7	14:38755	*See* DOE/ER/45347–13			
8	14:38791	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015043/JAW	MF-404
CONF-890723–		(26. annual conference on nuclear and space radiation effects; Marco Island, FL, USA; 24-28 Jul 1989)			
9	14:38965	*See* SAND–89-0248C			
10	14:38816	*See* SAND–89-0338C			
11	14:38993	*See* SAND–89-0249C			
CONF-890736–		(30. annual meeting of the Institute of Nuclear Materials Management; Orlando, FL, USA; 9-12 Jul 1989)			
32	14:38238	*See* DP-MS–89-44			
33	14:38235	*See* DP-MS–89-22			
35	14:38237	*See* DP-MS–89-43			
36	14:38098	*See* DP-MS–89-28			
37	14:38151	*See* DP-MS–88-187			
38	14:38153	*See* DP-MS–89-45			
39	14:38152	*See* DP-MS–89-13			
40	14:38236	*See* DP-MS–89-37			
41	14:38240	*See* K/ITP–252			
42	14:38241	*See* K/ITP–253			
43	14:38239	*See* K/ITP–250			
44	14:38245	*See* WHC-SA–0510			
45	14:38950	*See* WHC-SA–0655			
46	14:38246	*See* WHC-SA–0523			
47	14:38248	*See* WHC-SA–0525			
48	14:38247	*See* WHC-SA–0524			
49	14:38946	*See* SAND–89-1779C			
CONF-890796–		(International workshop on high power opening switches; Novosibirsk, USSR; 1-2 Jul 1989)			
2	14:39741	*See* LA-UR–89-1984			
CONF-890798–		(AIRAPT and EHPRG international high pressure science and technology conference; Paderborn, Germany, F.R.; 17-21 Jul 1989)			
2	14:38774	*See* SAND–89-0978C			
1-Vugraphs	14:38768	*See* LA-UR–89-2150			
CONF-890799–		(Space operations automation and robotics workshop; Houston, TX, USA; 25-27 Jul 1989)			
1	14:38797	*See* LA-UR–89-2168			
CONF-890811–		(9. international symposium on detonation; Portland, OR (USA); 28 Aug - 1 sep 1989)			
1	14:39103	*See* LA-UR–88-2753			
CONF-890812–		(American Physical Society topical conference on shock compression of condensed matter; Albuquerque, NM, USA; 14-17 Aug 1989)			
1	14:39405	*See* UCRL–100586			
CONF-890815–		(24. intersociety energy conversion engineering conference; Washington, DC, USA; 7-12 Aug 1989)			
1	14:38463	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89010169/JAW	MF-406
2	14:38465	*See* SAND–88-3375C			
3	14:38301	*See* SAND–89-1311C			
4	14:38302	*See* SERI/TP–211-3501			
5	14:38654	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012422/JAW	MF-210
6	14:38644	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013304/JAW	MF-112
7	14:38382	*See* LA-UR–89-1666			
8	14:38323	*See* SERI/TP–217-3506			
9	14:38324	*See* SERI/TP–217-3515			
10	14:38313	*See* SAND–88-3426C			
11	14:38310	*See* SAND–89-1474C			
12	14:39028	*See* UCRL–97820			
13	14:38309	*See* SAND–89-1349C			
14	14:38307	*See* SAND–88-3286C			
16	14:38687	*See* SAND–89-1598C			
CONF-890817–		(12. biennial conference on mixing; Potosi, MO (USA); 6-11 Aug 1989)			
2	14:38154	*See* DP-MS–89-61			
1-Vugraphs	14:38190	*See* WSRC-RP–89-124			

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CONF-890818–		(Guidance, navigation, and control conference; Boston, MA, USA; 14-16 Aug 1989)			
2	14:38939	*See* SAND–89-0195C			
3	14:38936	*See* SAND–88-2876C			
1-Draft	14:38686	*See* SAND–88-3031C			
CONF-890819–		(ASME/AIChE national heat transfer conference; Philadelphia, PA, USA; 6-9 Aug 1989)			
1	14:38988	*See* DP-MS–88-217			
2	14:38407	*See* SAND–88-7157C			
3	14:39105	*See* SAND–88-2947C			
4	14:39639	*See* SAND–88-0259C			
5	14:38942	*See* SAND–89-0360C			
6	14:38941	*See* SAND–89-0359C			
7	14:38418	*See* BNL-NUREG–42081			
8	14:38451	*See* SAND–89-0384C			
9	14:37941	*See* SAND–88-2710C			
10	14:38450	*See* SAND–88-7158C			
11	14:38990	*See* SAND–89-0326C			
13	14:38431	*See* EGG-M–89042			
15	14:38986	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012427/JAW	MF-262
16	14:37928	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013643/JAW	MF-103
17	14:38374	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013283/JAW	MF-520
18	14:38321	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013281/JAW	MF-262
19	14:38985	*See* BNL–42658			
CONF-890820–		(4. international symposium on environmental degradation of materials in nuclear power systems: water reactors; Jekyll Island, GA (USA); 6-10 Aug 1989)			
1	14:38369	*See* SAND–88-3347C			
CONF-890830–		(Calorimetry conference; Oak Ridge, TN (USA); 4 Aug 1989)			
1	14:38876	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89007831/JAW	MF-401
2	14:38877	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011227/JAW	MF-401
CONF-890834–		(International conference on parallel processing; St. Charles, IL, USA; 8-12 Aug 1989)			
1	14:39769	*See* LA-UR–88-4110			
CONF-890835–		(5. international conference on structural safety and reliability; San Francisco, CA, USA; 8-11 Aug 1989)			
1	14:38935	*See* SAND–88-1304C			
2	14:38772	*See* SAND–88-1163C			
CONF-890842–		(7. ADINA conference; Houston, TX, USA; 2-4 Aug 1989)			
1	14:38752	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89006624/JAW	MF-000
CONF-890844–		(18. international conference on parallel processing; Chicago, IL, USA; 8-12 Aug 1989)			
1	14:39543	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89006128/JAW	MF-420
CONF-890849–		(7. international conference on biomagnetism; New York, NY, USA; 14-18 Aug 1989)			
1	14:39275	*See* LA-UR–89-1729			
2	14:39273	*See* LA-UR–89-1579			
3	14:39344	*See* LA-UR–89-1731			
4	14:39345	*See* LA-UR–89-2221			
CONF-890852–		(ASME/NRC symposium on inservice testing of pumps and valves; Washington, DC, USA; 1-3 Aug 1989)			
1	14:38354	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89007838/JAW	MF-000
2	14:38357	*See* EGG-M–88527			
CONF-890853–		(3. international conference on surface modification technologies; Neuchatel (Switzerland); 28 Aug - 1 sep 1989)			
1	14:38882	*See* LA-UR–89-1882			
CONF-890854–		(11. annual DOE low level waste management conference; Pittsburgh, PA (USA); 22-24 Aug 1989)			
5	14:38188	*See* WHC-SA–0567			
CONF-890855–		(10. international conference on Structural Mechanics in Reactor Technology (SMIRT); Anaheim, CA, USA; 14-18 Aug 1989)			
1	14:38753	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89008605/JAW	MF-000
4	14:38175	*See* SAND–88-2486C			
5	14:38449	*See* SAND–88-2215C			

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6	14:38940	*See* SAND–89-0345C			
7	14:38440	*See* LA-UR–89-1120			
8	14:38422	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009781/JAW	MF-000
10	14:38389	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89008926/JAW	MF-000
11	14:39752	*See* UCRL–99395			
12	14:38448	*See* SAND–88-2214C			
13	14:38943	*See* SAND–89-0619C			
14	14:38925	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009783/JAW	MF-406
15	14:38428	*See* EGG-M–88343			
16	14:38187	*See* WHC-SA–0415			
17	14:38380	*See* WHC-SA–0546			
18	14:38413	*See* WHC-SA–0555			
19	14:38363	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89010259/JAW	MF-000
20	14:38391	*See* DP-MS–88-146			
21	14:38399	*See* SAND–88-2173C			
22	14:38173	*See* SAND–87-1937C			
23	14:39735	*See* GA-A–19623			
24	14:38429	*See* EGG-M–88346			
25	14:38430	*See* EGG-M–88347			
26	14:38365	*See* EGG-M–89093			
27	14:38364	*See* EGG-M–88422			
28	14:38356	*See* EGG-M–88205			
29	14:39700	*See* EGG-M–88201			
30	14:38174	*See* SAND–88-1931C			
31	14:38176	*See* SAND–88-7067C			
32	14:38754	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012344/JAW	MF-000
33	14:38390	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012391/JAW	MF-520
34	14:38423	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012379/JAW	MF-523
35	14:38926	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012423/JAW	MF-523
36	14:38424	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012424/JAW	MF-520
37	14:38425	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012389/JAW	MF-520
38	14:38426	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013173/JAW	MF-520
39	14:38427	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013195/JAW	MF-523
41	14:38924	*See* BNL-NUREG–42675			
42	14:38419	*See* BNL-NUREG–42674			
43	14:38103	*See* BNL-NUREG–42667			
45	14:38180	*See* SAND–89-7003C			
46	14:38177	*See* SAND–88-7070C			
47	14:38178	*See* SAND–88-7120C			
48	14:38420	*See* BNL-NUREG–42788			
49	14:38179	*See* SAND–89-1419C			
CONF-890867–		(6. international symposium on water-rock interaction; Malvern (UK); 3-9 Aug 1989)			
1	14:38138	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011237/JAW	MF-70
CONF-890878–		(6. international symposium on water-rock interaction; Malvern, UK; 3-12 Aug 1989)			
1	14:38320	*See* LA-UR–89-1899			
CONF-890885–		(Flash radiography topical symposium; Portland, OR (USA); 15-18 Aug 1989)			
1	14:38948	*See* UCRL–100939			
4	14:39106	*See* LA-UR–89-1933			
5	14:38874	*See* LA-UR–89-1936			
6	14:38873	*See* LA-UR–89-1935			
CONF-890891–		(International organization for crystal growth IOCG; Tokyo, Japan; Aug 1989)			
1	14:38813	*See* EGG–10617-2014			
CONF-890894–		(13. international workshop on condensed matter theories; Campos de Jordao (Brazil); 6-12 Aug 1989)			
1	14:39612	*See* LA-UR–89-2100			
CONF-890895–		(Polarization and correlation in electronic and atomic collisions; Hoboken, NJ, USA; 2-4 Aug 1989)			
1	14:39379	*See* LA-UR–89-2231			
CRN-PN–					
88-05	14:39491	NTIS (US Sales Only), PC A03/MF A01		DE89792007/JAW	MF-000
88-35	14:39493	NTIS (US Sales Only), PC A03/MF A01		DE89791986/JAW	MF-000
88-37	14:39494	NTIS (US Sales Only), PC A03/MF A01		DE89791985/JAW	MF-000
DAS–					
29	14:39780	*See* LPC–86-10			
DELPHI–					
86-43	14:39780	*See* LPC–86-10			

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DGMK–					
167-5	14:38025	Copy held by UB/TIB Hannover.			MF-000
300	14:38812	Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.)			ND-000
343-2	14:37979	Copy held by UB/TIB Hannover.			MF-000
354	14:37990	Copy held by UB/TIB Hannover.			MF-000
405	14:38023	Copy held by UB/TIB Hannover.			MF-000
418-2	14:37886	Copy held by UB/TIB Hannover.			MF-000
DOE/AL/25034–					
T1	14:38306	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014772/JAW	MF-234; MN-336
DOE/BC/10850–					
13	14:37947	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015484/JAW	MF-122
16	14:37980	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015487/JAW	MF-122
DOE/BC/14246–					
T2	14:37981	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015479/JAW	MF-122
DOE/CE/15257–					
T4	14:38464	NTIS, PC A05/MF A01 - OSTI		DE89007963/JAW	MF-202
DOE/CE/15384–					
T4	14:38927	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015481/JAW	MF-312
DOE/CE/90142–					
T1	14:38530	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015477/JAW	MF-220
DOE/EIA–					
0002	14:38531	NTIS, PC A03/MF A01 - GPO - OSTI		DE89014975/JAW	MF-950
0120(79)	14:37828	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014987/JAW	MF-950
0137/1	14:38519	NTIS, PC A03/MF A01 - GPO - OSTI		DE89014985/JAW	MF-950
0149(87)	14:38486	NTIS, PC A06/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89015127/JAW	MF-950
0173(80)/1	14:38467	NTIS, PC A05/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89015008/JAW	MF-950
0173(80)/2	14:38468	NTIS, PC A12/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89014982/JAW	MF-950
0173(80)/3SUM	14:38512	NTIS, PC A04/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89015012/JAW	MF-950
0173(81)SYN	14:38469	NTIS, PC A04/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89015007/JAW	MF-950
0173(SYN)	14:38471	NTIS, PC A04/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89015087/JAW	MF-950
0203/1	14:38472	NTIS, PC A03/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89014989/JAW	MF-950
0254	14:38697	NTIS, PC A21/MF A01 - GPO - OSTI		DE89014988/JAW	MF-950
0265(78)	14:37982	NTIS, PC A03/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89014996/JAW	MF-950
0266	14:38006	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014981/JAW	MF-950
0276	14:38473	NTIS, PC A03/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89015004/JAW	MF-950
0281	14:38474	NTIS, PC A03/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89015013/JAW	MF-950
0283	14:38520	NTIS, PC A18/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89015006/JAW	MF-950
0306	14:38690	NTIS, PC A04/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89014990/JAW	MF-950
0318(86)	14:38657	NTIS, PC A16/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89014829/JAW	MF-950
0354(81)	14:38639	NTIS, PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014994/JAW	MF-950
0355	14:38029	NTIS, PC A04/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89014986/JAW	MF-950
0368	14:38116	NTIS, PC A12/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89014992/JAW	MF-950
0373	14:38532	NTIS, PC A11/MF A01 - GPO - OSTI		DE89014974/JAW	MF-950
0374	14:38478	NTIS, PC A06/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89014998/JAW	MF-950
0386	14:38475	NTIS, PC A06/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89014999/JAW	MF-950
0410	14:38521	NTIS, PC A09/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89015030/JAW	MF-950
0465	14:38476	NTIS, PC A04/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89015745/JAW	MF-950
0475	14:38477	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014978/JAW	MF-950
0498	14:38691	NTIS, PC A03/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89014979/JAW	MF-950
0508	14:37999	NTIS, PC A03/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89015002/JAW	MF-950
0519	14:38479	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014980/JAW	MF-950
M038	14:38533	NTIS, PC A03/MF A01 - GPO - OSTI		DE89015158/JAW	MF-950
MDR-0269	14:38692	NTIS, PC A03/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89014997/JAW	MF-950
DOE/EIS–					
0113-Vol.1-Final	14:38139	NTIS, PC A17/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013905/JAW	MF-721
0113-Vol.2-Final	14:38140	NTIS, PC A16/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013904/JAW	MF-721
0113-Vol.3-Final	14:38141	NTIS, PC A18/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013903/JAW	MF-721
0113-Vol.4-Final	14:38142	NTIS, PC A17/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013902/JAW	MF-721
0113-Vol.5-Final	14:38143	NTIS, PC A99/MF A01 - OSTI		DE89013901/JAW	MF-721
DOE/ER–					
0414	14:39759	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014410/JAW	MF-400
DOE/ER/01428–					
T6	14:39437	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015047/JAW	MF-414
DOE/ER/13361–					
4	14:39360	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015101/JAW	MF-408
DOE/ER/13416–					
4	14:39359	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015442/JAW	MF-403

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/ER/13481–					
1	14:37887	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014556/JAW	MF-401
DOE/ER/13693–					
3	14:39204	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015093/JAW	MF-408
DOE/ER/40004–					
T3	14:39487	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014558/JAW	MF-414
DOE/ER/40085–					
16	14:39362	NTIS, PC A09/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014935/JAW	MF-412
DOE/ER/40150–					
77	14:39473	NTIS, PC A99/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014422/JAW	MF-414
DOE/ER/40372–					
T2	14:39034	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013679/JAW	MF-414
DOE/ER/40481–					
3	14:39495	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014564/JAW	MF-412
DOE/ER/45347–					
13	14:38755	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014937/JAW	MF-410; MN-404
DOE/ER/53221–					
4	14:39656	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015125/JAW	MF-420
DOE/ER/60333–					
7	14:39361	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015092/JAW	MF-403
DOE/ER/60485–					
2	14:39113	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015807/JAW	MF-402
DOE/ER/60519–					
4	14:39270	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015459/JAW	MF-408
DOE/ER/60524–					
3	14:39341	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013966/JAW	MF-408
DOE/ER/60546–					
5	14:38658	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014865/JAW	MF-402
DOE/ER/60594–					
T1	14:39350	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014850/JAW	MF-403
DOE/ER/60621–					
2	14:39205	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015499/JAW	MF-408
DOE/ER/60669–					
3	14:38659	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014864/JAW	MF-402
DOE/ET/51013–					
266	14:39699	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014858/JAW	MF-420
DOE/FE–					
0131	14:38035	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013914/JAW	MF-123
0136	14:37939	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013877/JAW	MF-126
DOE/FTR–					
9015462	14:39029	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015462/JAW	MF-414
9015463	14:39363	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015463/JAW	MF-412
DOE/HWP–					
84	14:38144	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015513/JAW	MF-721
DOE/ID/12772–					
1	14:38987	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009028/JAW	PC-310; STD-310
DOE/IR/05106–					
T100	14:38724	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013865/JAW	MF-350
T101	14:38494	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013866/JAW	MF-350
T102	14:38725	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013867/JAW	MF-350
T103	14:38668	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013868/JAW	MF-350
T104	14:38495	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013869/JAW	MF-350
T105	14:38726	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013870/JAW	MF-350
T106	14:38727	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015415/JAW	MF-350
T107	14:38728	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015416/JAW	MF-350
T108	14:38669	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015417/JAW	MF-350
T109	14:38729	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015418/JAW	MF-350
T110	14:38670	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015419/JAW	MF-350
T111	14:38730	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015420/JAW	MF-350
T113	14:38671	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015422/JAW	MF-350
T114	14:38997	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015423/JAW	MF-350
T115	14:38672	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015424/JAW	MF-350
T116	14:38534	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015425/JAW	MF-350
T117	14:38673	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015426/JAW	MF-350
T118	14:38674	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015427/JAW	MF-350
T119	14:38731	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015428/JAW	MF-350
T120	14:38732	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015429/JAW	MF-350

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
T121	14:38733	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015430/JAW	MF-350
T122	14:38734	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015431/JAW	MF-350
T123	14:38480	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015432/JAW	MF-350
T124	14:38735	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015433/JAW	MF-350
T125	14:38675	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015434/JAW	MF-350
T126	14:38736	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015435/JAW	MF-350
T127	14:38737	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015436/JAW	MF-350
T128	14:38747	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015437/JAW	MF-330
T129	14:38748	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015438/JAW	MF-330
T130	14:38676	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015439/JAW	MF-330; MN-350
T131	14:38677	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015440/JAW	MF-330
T132	14:38738	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015441/JAW	MF-350
T55	14:38698	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014914/JAW	MF-350
T56	14:38699	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014915/JAW	MF-350
T57	14:38700	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013821/JAW	MF-242
T58	14:38701	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013822/JAW	MF-350
T61	14:38702	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013825/JAW	MF-350
T62	14:38703	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013827/JAW	MF-350
T64	14:38704	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013829/JAW	MF-350
T65	14:38705	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013830/JAW	MF-350
T66	14:38706	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013826/JAW	MF-350
T69	14:38660	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013833/JAW	MF-350
T70	14:38707	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013834/JAW	MF-350
T71	14:38661	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013835/JAW	MF-350
T72	14:38662	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013836/JAW	MF-350
T73	14:38708	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013837/JAW	MF-350
T74	14:38663	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013838/JAW	MF-350
T74	14:38709	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013852/JAW	MF-350
T75	14:38710	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013839/JAW	MF-350
T77	14:38664	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013841/JAW	MF-350
T79	14:38711	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013843/JAW	MF-350
T80	14:38712	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013844/JAW	MF-350
T82	14:38665	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013846/JAW	MF-245
T83	14:38713	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013847/JAW	MF-249
T84	14:38714	NTIS, PC A05/MF A01 - OSTI		DE89013848/JAW	MF-350
T85	14:38715	Van Ness, Feldman, Sutcliffe, Curtis & Levenberg, P.C., 1050 Thomas-Jefferson Street, N.W., Washington, D.C. 20007			MF-350
T86	14:38716	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013850/JAW	MF-249
T87	14:38717	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013851/JAW	MF-249
T88	14:38718	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013853/JAW	MF-249
T90	14:38719	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013855/JAW	MF-249
T91	14:38746	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013856/JAW	MF-334
T92	14:38720	NTIS, PC A05/MF A01 - OSTI		DE89013857/JAW	MF-350
T93	14:38470	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013858/JAW	MF-350
T94	14:38721	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013859/JAW	MF-350
T95	14:38722	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013860/JAW	MF-249
T96	14:38666	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013861/JAW	MF-350
T97	14:38723	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013862/JAW	MF-350
T98	14:38667	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013863/JAW	MF-350
DOE/MC/11090– 2711	14:38073	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000996/JAW	MF-123
DOE/MC/19122– 2699-Vol.1	14:37829	NTIS, PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000980/JAW	PC-109; STD-109
2699-Vol.2	14:37830	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000981/JAW	PC-109; STD-109
DOE/MC/22137– 2704-Vol.2	14:37929	NTIS, PC A12/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000991/JAW	PC-109; STP-115; STD-109; STD-115
DOE/MC/24223– 2713	14:38655	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000999/JAW	MF-110

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/MC/24268–					
2700	14:37831	NTIS, PC A14/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000967/JAW	PC-109; STD-109
DOE/METC–					
89/6100	14:37832	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000905/JAW	MF-109
DOE/NE/34122–					
T1	14:38355	NTIS (US Sales Only), PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012643/JAW	MF-523
DOE/PC/70805–					
T2	14:37927	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89010823/JAW	PC-113; STD-113
DOE/PC/79674–					
T1	14:38645	NTIS, PC A09/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012447/JAW	PC-112; STD-112
DOE/PC/88915–					
T3	14:37833	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015150/JAW	MF-109
DOE/PC/88928–					
T1	14:37930	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015767/JAW	MF-103
DOE/PC/90013–					
T9	14:38282	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015817/JAW	MF-108
DOE/PE–					
0089	14:38535	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013915/JAW	PC-350
0090	14:38481	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013916/JAW	PC-900
DOE/PETC/TR–					
89/7	14:37825	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009026/JAW	PC-102; STD-102
DOE/RW–					
0212	14:38145	OSTI		TI89014823/JAW	MF-800
0237	14:39762	OSTI		TI89013880/JAW	MF-800
DOE/SF/11950–					
T8	14:38311	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015464/JAW	MF-231
DOE/WIPP–					
207-Rev.1	14:38150	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015454/JAW	MF-810
88-025	14:38146	NTIS, PC A14/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014885/JAW	MF-810
88-029	14:38147	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013214/JAW	MF-721
88-031	14:38148	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015457/JAW	MF-810
89/005	14:38149	NTIS, PC A09/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012965/JAW	MF-721
DP-MS–					
88-144	14:39763	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011630/JAW	MF-700
88-146	14:38391	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89010460/JAW	MF-731
88-187	14:38151	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014147/JAW	MF-706
88-217	14:38988	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89005320/JAW	MF-706
88-252	14:39162	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014138/JAW	MF-702
89-13	14:38152	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014151/JAW	MF-706
89-22	14:38235	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014143/JAW	MF-706
89-28	14:38098	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014140/JAW	MF-701
89-37	14:38236	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014149/JAW	MF-706
89-43	14:38237	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014141/JAW	MF-700
89-44	14:38238	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014145/JAW	MF-731
89-45	14:38153	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014150/JAW	MF-706
89-61	14:38154	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014139/JAW	MF-721
E–					
4004	14:39000	*See* N–89-18664			
EA–					
331/89	14:38368	*See* OEFZS–4495			
332/89	14:38406	*See* OEFZS–4496			
EC–					
E40-11/3-1988	14:38739	Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, Canada K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
EDF-DER-RA–					
1988-1	14:38487	NTIS (US Sales Only), PC A07/MF A01		DE89781450/JAW	MF-000
EGG–					
10617-2014	14:38813	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013092/JAW	MF-701
2542	14:38443	*See* NUREG/CR–5163			

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EGG-M–					
08487	14:38155	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89010999/JAW	MF-512; MN-516
88201	14:39700	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011135/JAW	MF-404; MN-406
88205	14:38356	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89010982/JAW	MF-000
88343	14:38428	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009739/JAW	MF-000
88346	14:38429	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89010996/JAW	MF-000
88347	14:38430	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89010997/JAW	MF-000
88422	14:38364	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011113/JAW	MF-000
88527	14:38357	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011110/JAW	MF-000
89042	14:38431	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89010973/JAW	MF-523
89093	14:38365	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011112/JAW	MF-000
EPRI-GS–					
6380	14:38319	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
6427	14:38347	Research Reports Center, Box 50409, Palo Alto, CA 94303			MF-000
EPRI-NP–					
6389	14:39352	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
6409	14:38105	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
6424-M	14:38358	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
6466-M	14:38392	Research Reports Center, Box 50490, Palo Alto, CA 94303			MF-000
EUR–					
11454	14:38156	NTIS (US Sales Only), PC A03/MF A01			MF-000
11705	14:39701	NTIS (US Sales Only), PC A24/MF A01			MF-000
11821	14:39136	NTIS (US Sales Only), PC A03/MF A01			MF-000
11866	14:38106	NTIS (US Sales Only), PC A07/MF A01			MF-000
11867	14:39545	NTIS (US Sales Only), PC A03/MF A01			MF-000
11870	14:39137	NTIS (US Sales Only), PC A03/MF A01			MF-000
11875	14:38157	NTIS (US Sales Only), PC A11/MF A01			MF-000
11882	14:39138	NTIS (US Sales Only), PC A05/MF A01			MF-000
11891	14:38158	NTIS (US Sales Only), PC A05/MF A01			MF-000
11927	14:38159	NTIS (US Sales Only), PC A05/MF A01			MF-000
11936	14:38989	NTIS (US Sales Only), PC A04/MF A01			MF-000
12048	14:38433	NTIS (US Sales Only), PC A04/MF A01			MF-000
FNAL/C–					
89/117-E	14:39418	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014862/JAW	MF-414
89/124	14:39767	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015018/JAW	MF-405
FRCEA-TH–					
92	14:39480	NTIS (US Sales Only), PC A07/MF A01		DE89791992/JAW	MF-000
FRNC-TH–					
3313	14:39505	NTIS (US Sales Only), PC A12/MF A01		DE89791991/JAW	MF-000
FhG-IzfP–					
870117-TW	14:38991	Fraunhofer-Institut fuer Zerstoerungsfreie Pruefverfahren, Saarbruecken (Germany, F.R.)			ND-000
GA-A–					
19419	14:38928	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014249/JAW	MF-820
19420	14:38929	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014248/JAW	MF-820
19623	14:39735	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89010866/JAW	MF-424
19714	14:38434	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014031/JAW	MF-522
GANIL-A–					
88-04	14:38255	NTIS (US Sales Only), PC A02/MF A01		DE89791993/JAW	MF-000
GANIL-P–					
88-15	14:39503	NTIS (US Sales Only), PC A03/MF A01		DE89789263/JAW	MF-000
89-04	14:39481	NTIS (US Sales Only), PC A06/MF A01		DE89792001/JAW	MF-000
GAO/NSIAD–					
87-159BR	14:38000	US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877			ND-00
88-181BR	14:38964	US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877			ND-00
GAO/RCED–					
87-122	14:38488	US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877			ND-00
87-124	14:38489	General Accounting Office, PO Box 6015, Gaithersburg, MD 20877			ND-00

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GAO/RCED–					
87-126	14:38090	US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877			ND-00
87-133BR	14:38031	US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877			ND-00
87-91	14:38283	General Accounting Office, PO Box 6015, Gaithersburg, MD 20877			ND-00
87-92	14:38107	General Accounting Office, PO Box 6015, Gaithersburg, MD 20877			ND-00
87-98	14:38001	General Accounting Office, PO Box 6015, Gaithersburg, MD 20877			ND-00
88-104	14:38522	General Accounting Office, PO Box 6015, Gaithersburg, MD 20877			ND-00
88-129	14:38160	General Accounting Office, PO Box 6015, Gaithersburg, MD 20877			ND-00
88-137	14:38490	US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877			ND-00
88-152	14:38523	General Accounting Office, PO Box 6015, Gaithersburg, MD 20877			ND-00
88-161	14:38524	General Accounting Office, PO Box 6015, Gaithersburg, MD 20877			ND-00
88-172	14:37834	General Accounting Office, PO Box 6015, Gaithersburg, MD 20877			ND-00
88-174	14:37940	General Accounting Office, PO Box 6015, Gaithersburg, MD 20877			ND-00
88-175FS	14:38525	General Accounting Office, PO Box 6015, Gaithersburg, MD 20877			ND-00
88-198	14:38526	General Accounting Office, PO Box 6015, Gaithersburg, MD 20877			ND-00
88-27	14:39260	US General Accounting Office, PO Box 6015, Gaithersburg, MD 20877			ND-00
GEH–					
26434-100	14:38930	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014969/JAW	MF-500
26434-200	14:38099	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015057/JAW	MF-500
26434-300	14:38931	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014167/JAW	MF-500
GKSS–					
88/E/16	14:38322	Special print from Int. J. Energy Res. (1988) v. 12 p. 113-123.			MF-000
88/E/65	14:39166				MF-000
88/E/66	14:38847	Special print from J. Trace and Microprobe Techniques (1988) v. 6(2) p. 271-294.			MF-000
88/E/67	14:38756	Also published in Textures and Microstructures, by Gordon and Breach Publishers (UK), 1988, v. 8-9, p. 429-441.			MF-000
GR-A–					
88-05	14:39295	library KNAW, P.O. Box 41950, 1009 DD Amsterdam, Netherlands			ND-000
HEDL-SA–					
3335	14:38375	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014951/JAW	MF-530
3599	14:38376	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014968/JAW	MF-528
3701	14:38435	NTIS, PC A02/MF A01 - OSTI		DE89014952/JAW	MF-530
HEDL-TME–					
79-79	14:38377	NTIS (US Sales Only), PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015757/JAW	PC-539; STD-542
HW–					
36226	14:38436	NTIS, PC A03/MF A01 - OSTI		DE89013135/JAW	MF-731
36621	14:38437	NTIS, PC A02/MF A01 - OSTI		DE89013134/JAW	MF-731
IAE–					
4569/3	14:38400	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631468/JAW	MF-000
4711/3	14:39373	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89630235/JAW	MF-000
4742/1	14:39374	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89630204/JAW	MF-000
IAEA-TECDOC–					
490	14:39281	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89619871/JAW	MF-000
IEACR–					
15	14:37935	IEA Coal Research, 14-15 Lower Grosvenor Place, London SW1W OEX, England			PC-000
IG–					
89/01	14:39172	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631118/JAW	MF-000
IGCAR–					
79	14:38848	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89630798/JAW	MF-000
80	14:38849	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89630799/JAW	MF-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
87	14:38850	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89630800/JAW	MF-000
88	14:38851	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89630801/JAW	MF-000
92	14:38852	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89630802/JAW	MF-000
95	14:38853	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89630803/JAW	MF-000
96	14:38794	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631032/JAW	MF-000
ILR-Mitt.–					
198(1988)	14:38304	Technische Univ. Berlin (Germany, F.R.). Inst. fuer Luft- und Raumfahrt			ND-000
INDC(JPN)–					
123/L	14:39488	*See* JAERI-M–89-047			
INIS-GB–					
191	14:39474	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89631626/JAW	MF-000
INIS-SU–					
88	14:38761	NTIS (US Sales Only), PC A04/MF A01; INIS		DE89012190/JAW	MF-000
INIS-mf–					
11458	14:39595	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89631327/JAW	MF-000
11459	14:38860	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89012192/JAW	MF-000
11467	14:39492	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE89630734/JAW	MF-000
11468	14:39419	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89630675/JAW	MF-000
11469	14:39420	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89630676/JAW	MF-000
11471	14:38864	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89630813/JAW	MF-000
11480	14:39760	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631627/JAW	MF-000
11481	14:38366	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631477/JAW	MF-000
IOM-TM–					
88-06	14:37936	Institute of Occupational Medicine, Edinburgh (United Kingdom)			ND-000
88-18	14:37937	Institute of Occupational Medicine, Edinburgh (United Kingdom)			ND-000
89-01	14:37926	Institute of Occupational Medicine, Edinburgh (United Kingdom)			ND-000
IPNO-DRE–					
88-14	14:39663	NTIS (US Sales Only), PC A03/MF A01		DE89789222/JAW	MF-000
88-16	14:39482	NTIS (US Sales Only), PC A03/MF A01		DE89792003/JAW	MF-000
88-22	14:39498	NTIS (US Sales Only), PC A03/MF A01		DE89792002/JAW	MF-000
88-29	14:39483	NTIS (US Sales Only), PC A02/MF A01		DE89792005/JAW	MF-000
89-01	14:39484	NTIS (US Sales Only), PC A03/MF A01		DE89792004/JAW	MF-000
IPSN–					
1/88-Vol.3	14:38814	*See* NUREG/CR–4530-Vol.3			
ISN–					
87-89	14:39540	NTIS (US Sales Only), PC A02/MF A01		DE89789230/JAW	MF-000
IYaF–					
88-34	14:39631	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89630105/JAW	MF-000
88-75	14:39453	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89630136/JAW	MF-000
JAERI-M–					
88-230	14:39737	NTIS (US Sales Only), PC A06/MF A01		DE89790754/JAW	MF-000
88-231	14:39664	NTIS (US Sales Only), PC A17/MF A01		DE89790776/JAW	MF-000
88-247	14:39738	NTIS (US Sales Only), PC A11/MF A01		DE89790753/JAW	MF-000
88-269	14:38411	NTIS (US Sales Only), PC A03/MF A01		DE89790941/JAW	MF-000
88-270	14:38766	NTIS (US Sales Only), PC A04/MF A01		DE89790898/JAW	MF-000
89-003	14:38412	NTIS (US Sales Only), PC A04/MF A01		DE89790900/JAW	MF-000
89-005	14:38371	NTIS (US Sales Only), PC A04/MF A01		DE89790942/JAW	MF-000
89-009	14:38932	NTIS (US Sales Only), PC A11/MF A01		DE89790944/JAW	MF-000
89-047	14:39488	NTIS (US Sales Only), PC A03/MF A01 - OSTI		DE89013906/JAW	MF-000
JET-R–					
88-13	14:39065	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631564/JAW	MF-000
88-16	14:39665	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89630499/JAW	MF-000
88-17	14:39666	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89630500/JAW	MF-000
89-01	14:39667	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89630501/JAW	MF-000
JINR-E–					
14-88-568	14:39609	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89630241/JAW	MF-000
14-88-583	14:39147	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89631089/JAW	MF-000
15-88-573	14:39508	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89630755/JAW	MF-000
2-88-418	14:39439	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89630641/JAW	MF-000
2-88-521	14:39440	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89630642/JAW	MF-000
3-88-459	14:39608	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89630242/JAW	MF-000
JINR-R–					
1-88-412	14:39489	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89630730/JAW	MF-000
1-88-417	14:39490	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89630731/JAW	MF-000
1-88-617	14:39421	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89630677/JAW	MF-000
10-88-490	14:39768	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89631617/JAW	MF-000
2-88-427	14:39441	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89630629/JAW	MF-000

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2-88-454	14:39638	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89630111/JAW	MF-000
4-88-587	14:39455	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89630138/JAW	MF-000
7-88-696	14:39005	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631428/JAW	MF-000
9-88-641	14:39016	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631441/JAW	MF-000
K/CSD/TM–					
86	14:38933	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014402/JAW	MF-505
K/ITP–					
250	14:38239	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015498/JAW	MF-515
252	14:38240	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015496/JAW	MF-515
253	14:38241	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015497/JAW	MF-515
K/QT–					
249/P	14:38097	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014522/JAW	MF-517
KEK–					
88-5	14:39066	NTIS (US Sales Only), PC A10/MF A01		DE89012160/JAW	MF-000
88-7	14:39018	NTIS (US Sales Only), PC A09/MF A01		DE89012159/JAW	MF-000
KEMA–					
19875	14:38439	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE89631285/JAW	MF-000
KIFVE–					
88-03	14:39081	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631546/JAW	MF-000
88-04	14:39477	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89630726/JAW	MF-000
KIYI–					
88-3	14:39006	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631429/JAW	MF-000
88-9	14:39670	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89630481/JAW	MF-000
88-12	14:39082	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631565/JAW	MF-000
88-27	14:39091	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631575/JAW	MF-000
KNMI–					
173	14:39143	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89631128/JAW	MF-000
LA–					
11574	14:38259	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014389/JAW	MF-500
11587	14:38749	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013899/JAW	MF-700
11595-PR	14:38161	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014390/JAW	MF-721
11600-PR	14:38843	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014385/JAW	MF-700; MN-712
11609-MS	14:38242	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014403/JAW	PC-700
11613-MS	14:38796	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014391/JAW	MF-702; MN-706
11632-MS	14:38243	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014413/JAW	PC-700
11638-PR	14:39023	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014392/JAW	MF-700
11643-M	14:39083	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89010726/JAW	MF-700
LA-UR–					
88-2753	14:39103	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE88016238/JAW	MF-741
88-4110	14:39769	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89005457/JAW	MF-705
89-1120	14:38440	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009250/JAW	MF-000
89-1579	14:39273	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013221/JAW	MF-408
89-1640	14:38318	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012611/JAW	MF-000
89-1666	14:38382	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013452/JAW	MF-528
89-1729	14:39275	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013438/JAW	MF-708
89-1731	14:39344	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013437/JAW	MF-408
89-1882	14:38882	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014242/JAW	MF-904
89-1899	14:38320	NTIS, PC A02/MF A01 - OSTI		DE89014238/JAW	MF-702
89-1933	14:39106	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014022/JAW	MF-000
89-1935	14:38873	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014048/JAW	MF-000
89-1936	14:38874	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014263/JAW	MF-000
89-1966	14:39423	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014256/JAW	MF-413
89-1984	14:39741	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014253/JAW	MF-706
89-1989	14:39206	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014252/JAW	MF-408
89-2010	14:39424	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014035/JAW	MF-700
89-2057	14:39478	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014309/JAW	MF-705
89-2100	14:39612	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014229/JAW	MF-700
89-2105	14:38767	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014228/JAW	MF-704
89-2127	14:39742	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014223/JAW	MF-423
89-2150	14:38768	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014288/JAW	MF-701
89-2168	14:38797	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014280/JAW	MF-000
89-2198	14:39207	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014273/JAW	MF-408
89-2221	14:39345	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014468/JAW	MF-708
89-2231	14:39379	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014467/JAW	MF-705
LAPP-EXP–					
88-14	14:39084	NTIS (US Sales Only), PC A03/MF A01		DE89791988/JAW	MF-000
88-15	14:39085	NTIS (US Sales Only), PC A03/MF A01		DE89791987/JAW	MF-000

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LAPP-TH–					
209-88	14:39422	NTIS (US Sales Only), PC A02/MF A01		DE89791989/JAW	MF-000
LBL–					
20096	14:38678	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014892/JAW	MF-402; MN-350
25451	14:39274	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014886/JAW	MF-407; MN-406
25588	14:38908	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014906/JAW	MF-401
25906	14:39007	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014910/JAW	MF-414
25916	14:39024	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015446/JAW	MF-414
25930	14:39025	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014911/JAW	MF-414
25931	14:39026	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014908/JAW	MF-414
26404	14:39380	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014883/JAW	MF-414
26862	14:39011	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013425/JAW	MF-414
27156	14:38162	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014889/JAW	MF-814
27157	14:38163	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014896/JAW	MF-802
27164	14:38883	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012991/JAW	MF-401
27175	14:37835	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014907/JAW	MF-109
27179	14:38164	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015444/JAW	MF-802
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27267	14:38798	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014893/JAW	MF-404
LBL-PUB–					
658	14:39092	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015447/JAW	MF-405; MN-406
LIS–					
82	14:39117	Landesanstalt fuer Immissionsschutz des Landes Nordrhein-Westfalen, Essen (Germany, F.R.)			ND-000
LPC–					
86-10	14:39780	NTIS (US Sales Only), PC A02/MF A01		DE89781512/JAW	MF-000
LYCEN-T–					
8837	14:39509	NTIS (US Sales Only), PC A04/MF A01		DE89792006/JAW	MF-000
MI–					
100/89	14:39761	*See* OEFZS–4493			
MICROLOG–					
89-01998	14:38739	*See* EC–E40-11/3-1988			
MLM–					
3587(OP)	14:39104	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014738/JAW	MF-741
3600	14:38770	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014407/JAW	PC-700
MPI-PAE/Exp.El.–					
199	14:39425	Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik			ND-000
MRL-R–					
1132	14:37991	*See* AD-A–205155/5/XAB			
N–					
89-18664	14:39000	NTIS, PC A03/MF A01			ND-00
NAS–					
1.15:100827	14:39000	*See* N–89-18664			
NASA-TM–					
100827	14:39000	*See* N–89-18664			
NEANDC(J)–					
136/U	14:39488	*See* JAERI-M–89-047			
NIKHEF-H–					
88-19	14:39456	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89630141/JAW	MF-000
89-3	14:39442	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89630630/JAW	MF-000
NRL-MR–					
6196	14:38809	*See* AD-A–204979/9/XAB			
NUREG–					
0020-Vol.13-No.6	14:38351	NTIS, PC A23/MF A01 - GPO - OSTI		TI89014835/JAW	MF-000
0540-Vol.2-No.4	14:38383	NTIS, PC A16/MF A01 - GPO - OSTI		TI89014421/JAW	MF-000
1217	14:38441	NTIS, PC A04/MF A01 - GPO - OSTI		TI89014849/JAW	MF-000
1272-Vol.3-No.1	14:38352	NTIS, PC A10/MF A01 - GPO - OSTI		TI89014541/JAW	MF-000
1272-Vol.3-No.2	14:38244	NTIS, PC A04/MF A01 - GPO - OSTI		TI89014260/JAW	MF-000
1360	14:38359	NTIS, PC A23/MF A01 - GPO - OSTI		TI89014158/JAW	MF-000
NUREG/CR–					
2000-Vol.8-No.5	14:38384	NTIS, PC A07/MF A01 - GPO - OSTI		TI89014112/JAW	MF-000
3964-Vol.1	14:38165	NTIS, PC A09/MF A01 - GPO - OSTI		TI89014183/JAW	MF-000
4530-Vol.3	14:38814	NTIS, PC A04/MF A01 - GPO - OSTI		TI89015455/JAW	MF-000

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NUREG/CR–					
5118	14:38442	NTIS, PC A08/MF A01 - GPO - OSTI		TI89014540/JAW	MF-000
5161-Vol.1	14:38397	NTIS, PC A08/MF A01 - GPO - OSTI		TI89014833/JAW	MF-000
5163	14:38443	NTIS, PC E16/MF E02 - GPO - OSTI		TI89012584/JAW	MF-000
5187	14:38444	NTIS, PC A06/MF A01 - GPO - OSTI		TI89015502/JAW	MF-000
5231	14:38398	NTIS, PC A03/MF A01 - GPO - OSTI		TI89014902/JAW	MF-000
5268	14:38445	NTIS, PC A10/MF A01 - GPO - OSTI		TI89014203/JAW	MF-000
5339	14:38405	NTIS, PC A04/MF A01 - GPO - OSTI		TI89015501/JAW	MF-000
5349	14:38367	NTIS, PC A06/MF A01 - GPO - OSTI		TI89014195/JAW	MF-000
5371	14:38446	NTIS, PC A05/MF A01 - GPO - OSTI		TI89014319/JAW	MF-000
5402	14:38166	NTIS, PC A06/MF A01 - GPO - OSTI		TI89013222/JAW	MF-000
NYU–					
9015489	14:38750	Center for War, Peace, and the News Media, New York University, 10 Washington Place, New York, NY 10003 (8.00)			ND-000
OEFZS–					
4482	14:38257	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89631411/JAW	MF-000
4485	14:38875	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89630765/JAW	MF-000
4493	14:39761	NTIS (US Sales Only), PC A09/MF A01 - OSTI; INIS		DE89631620/JAW	MF-000
4495	14:38368	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631478/JAW	MF-000
4496	14:38406	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631462/JAW	MF-000
ORAU–					
89/C-140	14:39770	NTIS, PC A09/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013888/JAW	MF-400
ORNL/FTR–					
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ORNL/M–					
873	14:38144	*See* DOE/HWP–84			
ORNL/NSIC–					
200-Vol.8-No.5	14:38384	*See* NUREG/CR–2000-Vol.8-No.5			
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11104	14:38405	*See* NUREG/CR–5339			
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OTA-BP-E–					
53	14:39346	GPO06/MF A01 - OSTI		TI89015488/JAW	MF-000
PATENTS-USA–					
4,808,318	14:38206	Patent and Trademark Office, Box 9, Washington, DC 20232			
4,818,295	14:38303	Patent and Trademark Office, Box 9, Washington, DC 20232			
4,818,479	14:38362	Patent and Trademark Office, Box 9, Washington, DC 20232			
4,808,271	14:38386	Patent and Trademark Office, Box 9, Washington, DC 20232			
4,780,270	14:38402	Patent and Trademark Office, Box 9, Washington, DC 20232			
4,818,448	14:38840	Patent and Trademark Office, Box 9, Washington, DC 20232			
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4,820,391	14:39002	Patent and Trademark Office, Box 9, Washington, DC 20232			
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4,784,737	14:39220	Patent and Trademark Office, Box 9, Washington, DC 20232			
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4,809,232	14:39779	Patent and Trademark Office, Box 9, Washington, DC 20232			
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89-162861/XAB	14:38484	NTISMF A01			ND-00
89-164552/XAB	14:39119	NTISCP D99			ND-00
89-168132/XAB	14:39277	NTISCP D02			ND-00
89-168579/XAB	14:38696	NTIS, PC A18/MF A01			ND-00
PFC/CP–					
89-2	14:39699	*See* DOE/ET/51013–266			
PNL–					
6462-Vol.1	14:38397	*See* NUREG/CR–5161-Vol.1			
6548	14:38348	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014381/JAW	MF-202
6574	14:38444	*See* NUREG/CR–5187			
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RICH–					
17	14:39780	*See* LPC–86-10			
SAIC–					
89/1113	14:38367	*See* NUREG/CR–5349			
SAND–					
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86-0196-Vol.1	14:38165	*See* NUREG/CR–3964-Vol.1			
86-0366-Vol.3	14:38814	*See* NUREG/CR–4530-Vol.3			
87-0310	14:39094	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014574/JAW	MF-000
87-0912	14:39107	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014399/JAW	MF-700
87-1433	14:38172	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014378/JAW	MF-814
87-1937C	14:38173	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89010742/JAW	MF-70

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88-1006	14:38934	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014379/JAW	MF-705
88-1054	14:38398	*See* NUREG/CR–5231			
88-1085	14:39123	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014398/JAW	PC-407
88-1163C	14:38772	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89008715/JAW	MF-704
88-1304C	14:38935	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89005595/JAW	MF-706
88-1931C	14:38174	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011540/JAW	MF-721
88-2173C	14:38399	NTIS, PC A02/MF A01 - OSTI		DE89010687/JAW	MF-706
88-2214C	14:38448	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89010031/JAW	MF-000
88-2215C	14:38449	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009328/JAW	MF-000
88-2486C	14:38175	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009378/JAW	MF-70
88-2710C	14:37941	NTIS, PC A03/MF A01 - OSTI		DE89010331/JAW	MF-701; MN-705
88-2876C	14:38936	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89007034/JAW	MF-706
88-2947C	14:39105	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89006768/JAW	MF-706
88-2974	14:38305	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014322/JAW	MF-276
88-3031C	14:38686	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89004824/JAW	MF-743; MN-705
88-3286C	14:38307	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013933/JAW	MF-336
88-3310C	14:38937	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014491/JAW	MF-700
88-3347C	14:38369	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013156/JAW	MF-523
88-3375C	14:38465	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011513/JAW	MF-210
88-3383	14:38938	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014374/JAW	MF-404
88-3426C	14:38313	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013088/JAW	MF-237
88-3431	14:39353	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013900/JAW	MF-253
88-7067C	14:38176	NTIS, PC A03/MF A01 - OSTI		DE89011396/JAW	MF-721
88-7070C	14:38177	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014691/JAW	MF-814
88-7120C	14:38178	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014707/JAW	MF-800
88-7155	14:38442	*See* NUREG/CR–5118			
88-7157C	14:38407	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89006166/JAW	MF-000
88-7158C	14:38450	NTIS, PC A03/MF A01 - OSTI		DE89010434/JAW	MF-000
89-0195C	14:38939	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89006723/JAW	MF-705
89-0248C	14:38965	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015493/JAW	MF-706
89-0249C	14:38993	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014939/JAW	MF-706; MN-704
89-0324C	14:38773	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014899/JAW	MF-704
89-0326C	14:38990	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89010436/JAW	MF-000
89-0338C	14:38816	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015491/JAW	MF-413
89-0345C	14:38940	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009329/JAW	MF-000
89-0359C	14:38941	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89007420/JAW	MF-706
89-0360C	14:38942	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89007429/JAW	MF-706
89-0384C	14:38451	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009796/JAW	MF-520
89-0550C	14:39773	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015492/JAW	MF-405
89-0619C	14:38943	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009335/JAW	MF-506
89-0737C	14:39774	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012678/JAW	MF-705
89-0902C	14:39485	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014021/JAW	MF-700
89-0927	14:38944	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014377/JAW	MF-414
89-0978C	14:38774	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013924/JAW	MF-704
89-1003C	14:38775	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014940/JAW	MF-704
89-1087	14:38945	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013875/JAW	MF-705
89-1237C	14:39404	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013580/JAW	MF-700
89-1248	14:38308	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014321/JAW	MF-234
89-1311C	14:38301	NTIS, PC A03/MF A01 - OSTI		DE89011842/JAW	MF-236; MN-96
89-1349C	14:38309	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014627/JAW	MF-236
89-1419C	14:38179	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013817/JAW	MF-721
89-1474C	14:38310	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013498/JAW	MF-235
89-1598C	14:38687	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014131/JAW	MF-706
89-1600C	14:38408	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014137/JAW	MF-000
89-1779C	14:38946	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014898/JAW	MF-722
89-7003C	14:38180	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014690/JAW	MF-814
89-7029	14:38314	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014376/JAW	MF-275
SECV-GO–					
88-148	14:38638	State Electricity Commission of Victoria, Melbourne (Australia). Research and Development Dept.			ND-000
SERI/TP–					
211-3501	14:38302	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009425/JAW	MF-270

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217-3506	14:38323	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009417/JAW	MF-261
217-3515	14:38324	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009424/JAW	MF-261
SFB–					
256-49(prepr.)	14:38349	Copy held by UB/TIB Hannover.			MF-000
256-60(prepr.)	14:38776	Copy held by UB/TIB Hannover.			MF-000
SLAC–					
345	14:39426	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014397/JAW	PC-414
SLAC-PUB–					
4890	14:39027	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014395/JAW	PC-414
4963	14:39008	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014400/JAW	PC-414
4971	14:39427	NTIS, PC A02/MF A01 - OSTI		DE89013891/JAW	PC-414
4992	14:39428	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013893/JAW	PC-414
4995	14:39429	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013894/JAW	PC-414
4998	14:39030	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013896/JAW	PC-414
5007	14:39430	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013897/JAW	PC-414
5012	14:39431	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013898/JAW	PC-414
SNV–					
3563	14:37925	Statens Naturvaardsverk, Solna (Sweden)			ND-000
SOL–					
89-6	14:39775	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014905/JAW	MF-405
STUDSVIK-STSRX–					
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Stralenbescherming–					
31	14:39336	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631151/JAW	MF-000
34	14:39598	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE89631329/JAW	MF-000
39-A	14:39337	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE89631197/JAW	MF-000
39-C	14:39599	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631295/JAW	MF-000
39-D	14:39600	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631296/JAW	MF-000
39-E	14:39601	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89631297/JAW	MF-000
39-F	14:38491	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89631604/JAW	MF-000
39-G	14:38452	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631287/JAW	MF-000
39-H	14:39338	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631198/JAW	MF-000
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UCID–					
21705	14:39743	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014405/JAW	MF-706
21734	14:39744	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014325/JAW	MF-411
UCRL–					
100586	14:39405	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011633/JAW	MF-706
100939	14:38948	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013808/JAW	MF-706
101139	14:38688	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014049/JAW	MF-900
101177	14:38994	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014038/JAW	MF-712
101197	14:39776	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014053/JAW	MF-705
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101264	14:38949	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014051/JAW	MF-705
53868-88	14:38992	NTIS, PC A14/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014320/JAW	PC-706
97820	14:39028	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013776/JAW	MF-000
99395	14:39752	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009950/JAW	MF-712
99592	14:39127	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015451/JAW	MF-402
99801	14:39095	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013787/JAW	MF-706
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02/88	14:39502	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89630749/JAW	MF-000
UJV–					
8525-T	14:38453	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89631621/JAW	MF-000
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UWThPh–					
1988-36	14:39640	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89630112/JAW	MF-000
1988-37	14:39443	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89630643/JAW	MF-000
1988-40	14:39641	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89630113/JAW	MF-000
1988-41	14:39444	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89630621/JAW	MF-000
1988-42	14:39642	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89630114/JAW	MF-000
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1989-2	14:39457	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89630145/JAW	MF-000
1989-5	14:39644	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89630116/JAW	MF-000
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1989-10	14:39445	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89630644/JAW	MF-000
1989-11	14:39645	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89630115/JAW	MF-000
1989-16	14:39459	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89630144/JAW	MF-000

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80406/11-88-5337/84	14:39598	*See* Stralenbescherming–34			
80495/12-88	14:38492	Library KNAW, P.O. Box 41950, 1009 DD Amsterdam, Netherlands			ND-000
WCWWA–					
8710	14:39174	Western Canada Water and Wastewater Association, P.O. Box 6168, Postal Station A, Calgary, AB, Canada T2H 2L4; $20.00 CAN; MF CAN-MET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
WHC-EP–					
0216	14:38181	NTIS, PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013925/JAW	MF-603
0224	14:38182	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014948/JAW	MF-721
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0096	14:38379	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014955/JAW	MF-528
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0415	14:38187	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89010108/JAW	MF-722
0503	14:38409	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014946/JAW	MF-507; MN-530
0510	14:38245	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014949/JAW	MF-700
0523	14:38246	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014959/JAW	MF-706
0524	14:38247	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014956/JAW	MF-706
0525	14:38248	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014958/JAW	MF-706
0546	14:38380	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89010090/JAW	MF-520
0555	14:38413	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89010091/JAW	MF-520
0567	14:38188	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014945/JAW	MF-721
0655	14:38950	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014950/JAW	MF-722
WINCO–					
1064	14:38189	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014406/JAW	PC-510
WSRC-RP–					
89-124	14:38190	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013555/JAW	MF-706
89-185	14:39339	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014152/JAW	MF-702
ZJE–					
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VN Viet Nam

WS Western Samoa

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